AN ANALYSIS OF THE KNOWLEDGE TRANSFER PARADOX IN PROJECTS WITH AN OPERATIONAL IMPROVEMENT OBJECTIVE IN MINES

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ABSTRACT

The execution of operational improvement projects can create new knowledge that can be used to contribute to the success of future projects. A paradox exists, in that new knowledge is seldom transferred to future projects, and so the associated value-adding opportunities are lost. The objectives of this study are to determine whether lessons learned are captured during operational improvement projects, and to identify contextual factors that support or hinder the knowledge transfer processes.

Through the use of interviews and subsequent data analysis, the research shows that the transfer of knowledge can be better facilitated by addressing the knowledge transfer inhibitors, recognising the value-adding potential of knowledge transfer during the execution of improvement projects, and creating a culture that is conducive to sharing knowledge – in particular, the lessons learned from mistakes and poor management practices.

OPSOMMING

Die uitvoering van operasionele verbeteringsprojekte kan nuwe kennis skep wat gebruik kan word en om by te dra tot die sukses van toekomstige projekte. 'n Paradoks bestaan, deurdat nuwe kennis selde na toekomstige projekte oorgedra word, en dus gaan die gepaardgaande waardetoevoegingsgeleenthede verlore. Die doelwitte van hierdie studie is om vas te stel of lesse wat geleer is tydens operasionele verbeteringsprojekte vasgelê word, en om kontekstuele faktore te identifiseer wat die kennisoordragprosesse ondersteun of belemmer.

Deur die gebruik van onderhoude en daaropvolgende data-analise toon die navorsing dat die oordrag van kennis beter gefasiliteer kan word deur die kennisoordrag-inhibeerders aan te spreek, die waardetoevoegende potensiaal van kennisoordrag tydens die uitvoering van verbeteringsprojekte te erken en 'n kultuur te skep wat is bevorderlik vir die deel van kennis, – veral die lesse wat uit foute en swak bestuurspraktyke geleer word.

1. INTRODUCTION

To remain competitive in an increasingly stringent economic and social responsibility environment, mines often embark on projects to improve their performance. These initiatives are typically smaller projects with a life cycle seldom exceeding a year. For these smaller operational improvement projects on a mine, the acronym 'IPM' is used in this paper.

Louw, Steyn and Van Waveren [1] state that project teams face specific challenges because projects are unique, multi-disciplinary, and temporary. This phenomenon is arguably even more valid for IPMs, for which normal operational personnel are appointed as temporary project team members, often with very scant project management skills. The project would normally be an additional responsibility to their operational day jobs.

The uniqueness of projects also results in new knowledge being created in executing these improvement projects; but the paradox is that this knowledge is seldom transferred to future projects at the mine or in the company. This means that a wealth of knowledge and value-adding opportunities is lost.

It is postulated, therefore, that mines do not have systems to transfer knowledge, such as lessons learned from previous improvement projects, to team members of new IPMs. Knowledge transfer is further inhibited by temporarily appointed project managers and project teams, as it is unlikely that they will implement more than two or three improvement projects during their career. Another inhibitor to knowledge transfer in IPMs is that, because of their normal day job responsibilities, the operational staff are unlikely to have the time or inclination to receive and absorb knowledge from previous projects; and so the incentive to learn is low.

This research seeks to identify why knowledge is not transferred between IPMs and what the inhibitors are that hinder knowledge transfer, and to propose mechanisms to overcome this shortcoming. The research determines whether mining companies have knowledge management processes for IPMs and, if they do not, why not; and where systems do exist, how they function, and whether they improve IPMs' chances of success. The final objective of this research is to develop a conceptual model to assist mines to improve knowledge transfer and thus the eventual success of IPMs.

To achieve the research objectives, the following research questions were formulated:

1. Are lessons learned (knowledge gained) from operational improvement projects on mines collected and transferred to future projects and projects teams?
2. If knowledge gained from operational improvement projects on mines is not collected and transferred to future projects and projects teams, why not?
3. What types of knowledge management process and/or system would be appropriate for IPMs?

2. KNOWLEDGE IN PROJECTS

2.1. Knowledge type

Knowledge can be either tacit or explicit [2]. The extent to which a particular body of knowledge can be codified can be placed on a continuum scale, as shown in Figure 1, with tacit and explicit knowledge as the two extremes [3], [4]. Between these two extremes, two examples of knowledge can be described that are typical for IPMs, namely 'learnings' and 'information'.

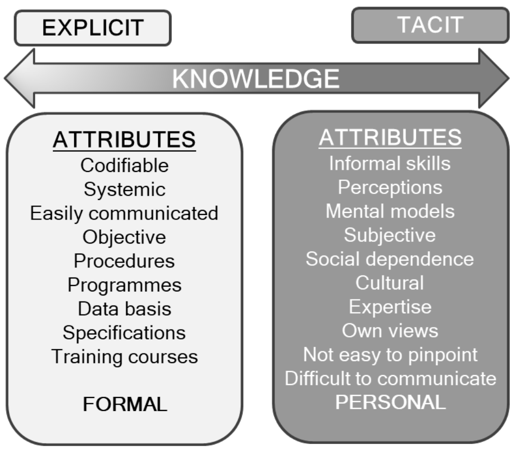

Figure 1: Knowledge explicitness on a continuum scale

Learnings are the knowledge required by individuals in a project to enable them to conduct the project better. It is the knowledge that can be learned like a skill or as experience that is gained; it will remain with individuals as lessons learned, and will enhance their ability to do their work. Once a lesson is learned or this type of knowledge is obtained, it remains within the experience repository of each individual.

On the other hand, the information required to manage a project will include data and facts, and the nature of the information will depend on the type of project. For IPMs, the information that is typically required includes that which is obtained during the study phases and approvals for the project, and from historical equipment and operational performances, labour structures and strengths, costs and revenue factors, etc. As information is mostly specific to a project, there might even be no need to transfer it to another project.

To a certain extent, the 'lessons learned' knowledge can be placed anywhere on the explicitness continuum. It might be from a training course (mainly explicit knowledge), or the knowledge obtained from a colleague, from expert consultation, or during a workshop or informal discussion (mainly tacit knowledge).

2.2. Knowledge transfer

The management of knowledge occurs through knowledge management processes. These include the identification, capturing, acquiring, creating, assembling, storing, integrating, retrieving, sharing, transferring, and using of knowledge [5]. Knowledge management also follows the core competencies of a company; in other words, the processes in which knowledge management is most commonly active also correspond with the processes in which the companies locate their core competencies [6]. This is particularly true for production-oriented companies, but not well-established for project-oriented ones.

As part of the knowledge management processes ,and to assist with the transferring and sharing of knowledge, a variety of knowledge transfer mechanisms are available. In a study by Van Waveren, Oerlemans and Pretorius [4], 59 different types of transfer mechanism were identified. Through a latent class analysis, these were grouped according to their characteristics into five clusters: (1) formal codification, (2) training and coaching, (3) informal person-to-person, (4) inter-organisational networking, and (5) the intra-organisation communal landscape of project-to-project knowledge transfer mechanisms. These are depicted in Table 1. The knowledge transfer mechanisms from these five clusters can be considered for application in knowledge transfer initiatives in IPMs.

Table 1: Knowledge transfer mechanisms for consideration in IPMs [4]

Cluster 1 Formal codification	Cluster 2 Training and coaching	Cluster 3 Informal person-to-person	Cluster 4 Inter-org networking	Cluster 5 Intra-org community of practice
Lessons learned logs Templates and checklists Common practices Project reports Internal documents Project reviews	Coaching/mentoring Expert consultant Formal meetings Collaborative problem-solving Project briefing/review session Stage review Teamwork session Site visits Champion visits	Face-to-face Informal chatting Informal meetings Social activities Instant messaging Telephone/video conversation	Email Internet Social networks	Teleconferencing Video conferencing

2.3. Contextual factors

The core activities of the knowledge processes are influenced by additional enabling factors. In a study by Heisig and others [7]–[9], it was noticed that six key enablers can have an impact on sustainable knowledge management to make it successful. Heisig *et al*. called them "context factors", and considered them to be critical for the success of knowledge transfer. Although not an exhaustive list, the context factors discussed below are relevant to knowledge transfer in IPMs.

Social aspects: The social standing of the organisation, project, and individuals plays a major role in facilitating knowledge transfer to new or other projects. Bartsch, Ebers and Maurer [10] describe the social aspect as a cardinal enabler of knowledge transfer, and emphasise that the social ties between project teams and their co-workers assist in learning because those ties can influence their motivation, opportunities, and ability to share knowledge between projects. Bartsch *et al.* also note that solid interpersonal and cognitive ties between project team members and their peers can be an important foundation for organisational stability and continuity.

Culture and trust: The organisational, environmental, social, and individual cultures that are prevalent in projects are important determinants of the type of knowledge transfer mechanism to use and of the success of such knowledge transfer between projects [11]. This is confirmed by various scholars, who mention that two-thirds of the effort, time, and cost of knowledge management has to do with the culture and employees in a company [12], and that shared cultural values can support organisational and project performance by enhancing factors such as like motivation, internal controls, coordination, common goals, and individual identification [13]. Where there is a learning culture and a natural willingness to share knowledge in an organisation, it can be related to the organisational culture and a sense of trust among people [14], [15].

Both organisational and individual cultural aspects play a role in the management and success of knowledge sharing at mines. When stimulating knowledge transfer to and between IPMs, the enhancing and inhibiting impacts of culture have to be considered.

Inhibitors of knowledge transfer: The temporary nature of projects is one of the main inhibitors that limit the assimilation of new knowledge by team members working on other projects [16]. IPM project team members have demanding deadlines, and are overloaded with work to deliver on project requirements while they are only temporarily allocated to the project. This forces them to focus on the goals and tasks at hand and not on knowledge management per se. This time constraint may even be exacerbated in IPMs where the team members are operational personnel who are executing the IPM as an additional job, and who may not be involved in the next project; thus the incentive to capture and transfer knowledge would be even lower.

2.4. Knowledge transfer success

Important to the success of knowledge transfer is the nature of the knowledge source, the receiver, the knowledge itself, the context in which the knowledge transfer takes place, and the recipient's ability to absorb the knowledge [17]–[19].

The use of information technology (IT) undoubtedly also plays a major role in knowledge transfer success. Some elements of IT provide mechanisms, while others act as promoters of knowledge transfer. IT facilitates communication via social media, without which knowledge transfer would be inefficient in today's world of digitisation and globalisation [14]. IT increases communication frequency and, having no distance limitations, alleviates the limitations of knowledge transfer for projects that are geographically far apart [20]. The Internet and digital technology, together with the power of video and mobile devices, are having a significant impact on the success of knowledge transfer [21].

Ultimately, for knowledge transfer to be successful, the knowledge must be used, and it should also have a positive effect on the outcome, namely the IPMs. A limitation of this research was that it did not include an investigation into transfer success parameters.

In the next section a conceptual model is developed that draws from the research about what knowledge is – in particular, the scale of explicitness of knowledge – the knowledge transfer mechanisms, and their application in different environments that are relevant to IPMs and the controlling impacts derived from the contextual factors.

3. A CONCEPTUAL MODEL FOR KNOWLEDGE TRANSFER IN IPMS

The uniqueness of IPMs dictates that it requires a specific approach to knowledge transfer. The uniqueness stems from several factors:

- An IPM is mostly a once-off project without a related project history or a follow-up project;
- IPM team members are normally sourced from the operating staff on the mine, and accept the project responsibilities in addition to their normal daily responsibilities;
- Team members in an IPM seldom have formal project management knowledge or project implementation experience;
- The organisational culture at a mine is not project-oriented; thus in most cases mines do not have project systems and processes;
- Project knowledge repositories do not exist at mines, and;
- An IPM, in most cases, is not a stand-alone exercise, and has to be integrated with the existing mining operations without undue interruptions.

These factors need to be considered when a model to facilitate or enhance knowledge transfer for IPMs is created.

Three main concepts found in the literature were used to develop a conceptual model for this research.

First, knowledge exists on a continuum scale of explicitness. The source of the knowledge would determine the state of the knowledge that needs to be transferred in IPMs. This could be anywhere on the continuum scale between tacit and explicit knowledge.

Second, different transfer mechanisms are available for use on IPMs that both the training and coaching cluster and the informal person-to-person cluster could adopt to enhance knowledge transfer between IPMs. As social media is already a commonly used medium to enhance operational management on a mine, it could be a convenient platform on which to post links to sources of knowledge for IPM team members.

Third, some contextual factors are likely to have an impact on the success of knowledge transfer to new IPMs. The social disposition and organisation culture at a mine are contextual factors that can have either a positive or a negative impact on the project. One of the advantages of the uniqueness of IPMs is that the project team plays an extraordinary role at the mine, and therefore attracts more attention from both management and co-workers. As the project has an improvement objective, there is an expectation of improvement for the mine as a whole. This tends to have a positive impact on the social disposition of the mine. In a study by Fourie [22] it was observed that more people wanted to be part of the improvement initiative, and that this resulted in a more highly motivated workforce.

Although not specifically researched, time, budget, and competency constraints are also common in IPMs, and are examples of inhibitors that regularly have a negative impact on project success. Other contextual factors that affect IPMs are that the project is executed in the normal operating environment and conditions of the mine, and that it is always subject to company and mine management strategies.

The resulting conceptual model is depicted in Figure 2.

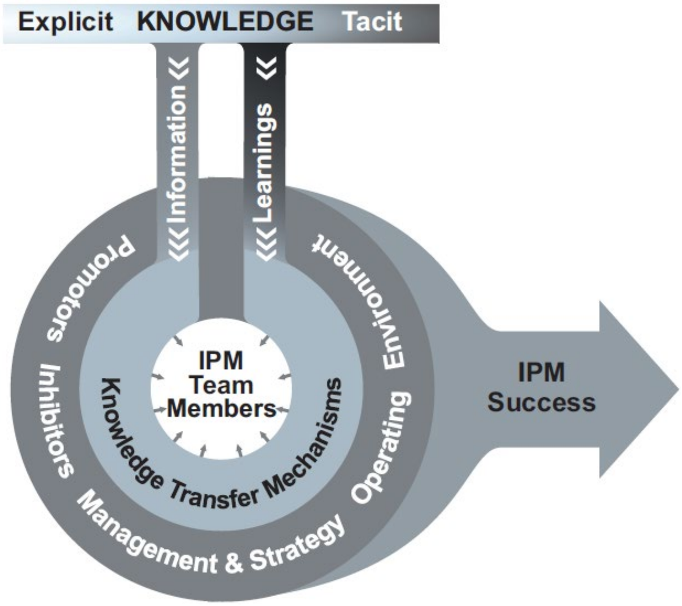

Figure 2: Conceptual model for knowledge transfer at IPMs

The model contains the following elements:

- A knowledge repository consisting of various sources of knowledge, all of which are located on the continuum scale of knowledge explicitness. This repository is not necessarily a defined entity; thus the knowledge seekers will have to know where to find or how to access the knowledge.
- Knowledge is called for by IPM team members when required, either as information or as learnings. Information knowledge is likely to be at the explicit end of the scale, while learnings knowledge will have components that lean towards the tacit end of the scale.
- A range of knowledge transfer mechanisms will be adopted or come into play to facilitate the transfer of information to the IPM and its team members. The most likely mechanisms to be adopted are listed in Table 1.
- The transfer of knowledge happens within the bounds of the contextual factors that have an impact on it. These are project success promotors and inhibitors, the operating environment of the mine, and the mine management and their strategies.
- When knowledge is transferred to the IPM team, the likely result or outflow is enhanced knowledge use and the subsequent success of the IPM.

From the conceptual model, a set of propositions were postulated and tested as part of the research to provide clarity and support for the model in order to enhance the chances of IPM success.

3.1. Research propositions

Owing to a lack of evidence, no support could be found for the idea that knowledge generated from IPMs is collected and transferred to future projects by operating mines. This provided the first proposition, as it is the reason for this research.

P1: Knowledge generated (lessons learned) from operational improvement projects is not formally collected and transferred to future projects by operating mines.

Any project needs at least two kinds of knowledge in order to be managed: information and learnings. The explicitness of these two kinds of knowledge tends to be different, with information leaning towards explicit knowledge on the continuum scale, while learnings can be anywhere on the scale; but learnings would lend towards tacit knowledge on mines because of the absence of formal knowledge repositories. If this theory is true, the mechanisms to transfer information and learnings will be different.

P2: Learnings and information knowledge require different mechanisms to be transferred to new IPMs.

Knowledge is not readily available to team members of a new IPM, as systems and processes to collect and store project-related knowledge do not generally exist on mines. Teams will have to ask and search for the knowledge they require.

P3: Knowledge required for new IPMs is not explicitly available, but must be sought by project team members.

Projects are not the primary focus of a mining operation, and the measures that would enhance project success are not prominent in a mine's management models.

P4: Mines are generally ignorant about the value-adding opportunity available when knowledge is consciously and properly transferred to new IPMs.

IPM team members are normally sourced from the operating staff on the mine, and so they are unlikely to have project management experience because it is not their principal job.

P5: IPM team members are mostly inexperienced in project management.

Successful knowledge management depends on contextual factors. The factors pertaining to IPMs are indicated in the outer circle of the conceptual model.

P6: Contextual factors have a significant impact on knowledge transfer success, and must be managed appropriately.

4. RESEARCH METHOD

The research approach was qualitative, and consisted of in-depth interviews with thirteen respondents selected from three large mining houses in South Africa. According to Guest, Bunce and Johnson [23], response data saturation typically happens after twelve interviews; therefore, the number of interviews was sufficient for this study.

Respondents were selected on the basis of their involvement in improvement projects on mines, their seniority in the mining company, and the role they had played in previous projects. The research strategy that was followed was to use the researcher's existing connections at the three mining houses to obtain access to the respondents who were selected for the interviews.

The interviews were facilitated by a prepared list of ten questions to support the research objectives, but avoiding leading questions so as not to produce biased responses. The interviewer was alert to identifying trends and to developing these further during the interviews, especially if they had the potential to reveal underlying reasons to support or refute the propositions.

5. RESEARCH RESULTS

Six of the thirteen interviews were conducted face-to-face before the COVID-19 lockdown, and the remaining seven were conducted online via video conferencing. Details of the results are discussed below.

5.1. Data collected

The thirteen interviews were transcribed using Otter (© 2020 Otter.ai) software. The transcriptions were studied and, while bearing the six propositions and three research questions in mind, the researcher formulated a set of 18 statements that could be tested in each transcription with a dichotomous outcome of either 'Yes' or 'No'. In some instances, the interview discussion resulted in a different insight that did not allow for a clear-cut response, and an 'Other response' outcome was then allocated.

5.2. Analysis of the statements

By classifying the respondents' dichotomous responses for each of the 18 statements, a quantitative result could be determined. Where the topic of the statement was not discussed, it was excluded from the denominator in the percentage calculation. The results are shown in Table 2.

When a result of more than 70% or less than 30% was scored in the dichotomous evaluation, it was regarded as grounded evidence that the statement was either valid or invalid. These were used as indicators in the analysis of the data.

Table 2: Statements formulated from data collected

Statement #	Proposition	Statement	Yes	No	Other response
S1	Dem	Respondent previously or currently involved in IPMs	100%	0%	0%
S2	Dem	Respondent previously or currently involved in larger projects	62%	38%	0%
S3	P5	The respondent has formal project management training	42%	58%	0%
S4	P5	IPM team members have formal project management training	0%	89%	**11%**
S5	P5	IPM teams are inexperienced in project management	73%	**9%**	**18%**
S6	P5	IPM team members are sourced from operating staff	92%	0%	**8%**
S7	P3	Project information is not explicitly available, but must be pulled	50%	**25%**	**25%**
S8	P4	IPM's success are measured (schedule, cost & deliverables)	54%	**23%**	**23%**
S9	P4	IPMs are completed within the scheduled time and budget and deliver on expectations	**6%**	72%	22%
S10	P1	Lessons learned from IPMs are collected	0%	77%	**23%**
S11	Q1	Project knowledge repositories for IPMs do exist	0%	92%	**8%**
S12	P1	Lessons learned from IPMs are transferred to future IPMs	**15%**	62%	**23%**
S13	Q2	Knowledge transfer systems / mechanisms exist for IPMs at mines	0%	77%	**23%**
S14	P4	Knowledge transfer between IPMs improves project success and adds value to the mine	100%	0%	0%
S15	P4	Mines are ignorant about the value-adding opportunities of knowledge transfer to new IPMs	78%	0%	**22%**
S16	P4	There are project management offices or other forms of project management support for IPMs at the mines	92%	**8%**	0%
S17	P6	Social media can be used to transfer lessons learned between IPMs	50%	**25%**	**25%**
S18	P6	Informal communications can be used to transfer lessons learned	82%	0%	**18%**

Notes: 1. Proposition P2 was tested indirectly through the use of the above statements.

2. Research question Q3 was answered through the general responses to the above statements.

3. The abbreviation 'Dem' was used for the respondent demographics statements.

A description and the responses to statements are provided below.

S1 to S3: Demographics of the respondents

The respondents were all from a technical mining background with more than ten years of operational experience in mining, and all had prior experience in IPMs. Eight of the respondents were based on a mine and five in a head office environment; five were in middle management and the rest in senior management positions. The thirteen respondents formed a diverse group who had credible knowledge of IPMs, and who provided a variety of insights into the management, execution, and transferring of knowledge in IPMs.

S4: IPM team members have formal project management training

With one or two exceptions, none of the IPM team members with whom the respondents had worked had formal project management training. One respondent commented: *"… the projects that I've mentioned, [list of projects], the people managing it has got zero project management skills"*.

S5: IPM teams are inexperienced in project management

With 73% of the respondents supporting S5 and only 9% not supporting it, it can be accepted that grounded support was obtained for Proposition 5. It was confirmed by a respondent who commented: *"To get stuck between the operational world and a project world is a terrible place to be, especially if you don't have much project experience"*.

S6: IPM team members are sourced from operating staff

The vast majority of IPM team members are sourced from the mine's operating staff, as confirmed by a respondent who replied: *"But when you go to smaller projects, especially the working cost projects, the production [i.e., operational] personnel do it themselves"*.

This is to be expected, because IPMs are operational improvement projects; so the ownership of a new initiative has to rest with the users to ensure its acceptance; and the users are the operating personnel. Operating personnel are normally trained in operational management and not in project management, as supported by the findings in S5. They are also under continuous work pressure, as their regular workload is normally not reduced when they also take on the project work. This issue was mentioned by several respondents – e.g., *"The problem is they then give it down to a guy that has his normal maintenance work to do and then he's got to do this project as well … So, we fail – on small projects we fail"*.

S7: Project Information is not explicitly available, but must be pulled

With only 50% of respondents supporting S7, it cannot be regarded as a valid statement. One respondent explained that the senior management at a mine has the responsibility of providing project information, stating: *"That type of information would sit across a few business areas on the mine. But ultimately if it's something that is in mining, then you look into the eyes of the manager mining to consolidate the data and provide it to him"*.

S7 was derived from Proposition 3; but, because S7 was not sufficiently valid, Proposition 3 was revised as follows: 'Knowledge required for new IPMs is not always readily available and must regularly be sought by project team members'.

S8: IPMs' successes are measured (schedule, cost, and deliverables)

About half (54%) of the respondents indicated that IPMs were measured for success in respect of project schedule, cost, and deliverables. Project management offices had been established in the previous two years at five of the six mines covered in the research (S16), and there were business improvement departments at four of the mines. Both of these were used to measure project performance to some extent.

S9: IPMs are completed within the scheduled time and budget and deliver on expectations

The respondents clearly indicated that, by large, IPMs were not completed within the time scheduled and did not deliver what was expected. This was supported by a respondent who remarked: *"But we very easily let the schedule slip because of other work. Because remember now, it's not a 'formal' project. This was bolted onto operational people's responsibilities"*.

The cost for IPMs is often absorbed into the operating cost budget, and it is then not possible to determine the direct project expenses.

S10: Lessons learned from IPMs are collected

None of the respondents indicated that the lessons learned were collected. The comment from one respondent represented the sentiment of several others who recognised this general shortcoming in the management of IPMs: *"Lessons learned are incredibly important, it is a shame that we don't keep a record of it"*. Another respondent put it more bluntly: *"We just kid ourselves, as we don't document lessons learned … but the formal closure of the project, which is learnings and so on, no, that we don't put in place"*.

S11: Project knowledge repositories for IPMs do exist

With 92% of the respondents not supporting this statement, it could be concluded that knowledge or lessons-learned repositories for IPMs did not exist at mines. One respondent stated: *"I'm not aware of any data set or software system that exists where one would capture learnings and successes and failures*". This was echoed by another: *"If you ask me if we keep a record of lessons learned, my answer is a definite no!"*.

S12: Lessons learned from IPMs are transferred to future IPMs

Only 62% of the respondents responded negatively to this statement, so the answer was not conclusive. However, there were strong views from some respondents, such as this one: *"But where are those learnings now from [another] concentrator? You could just copy and paste it. So that's a perfect example of one that we built just two years ago – in the same area, not even a kilometre apart!"*. The 23% 'Other responses' indicated that some informal transfer of lessons learned did take place through social media or the informal socialising of project team members.

S12 was used to test support for Proposition 1; but since it did not provide conclusive evidence, Proposition 1 was reworded as follows: 'Knowledge generated (lessons learned) from operational improvement projects are not formally collected and transferred to future projects by operating mines; however, informal transfer of lessons learned does occur'.

S13: Knowledge transfer systems/mechanisms exist for IPMs at mines

The 77% of 'No' responses to S13 provide grounded evidence that knowledge transfer systems or mechanisms for IPMs did not exist at mines. S13 was formulated to answer research question 2 ('If knowledge gained from operational improvement projects on mines is not collected and transferred to future projects and projects teams, why not?'). The responses indicated that part of the answer was that there was no knowledge transfer system or mechanism at mines.

S14: Knowledge transfer between IPMs improves project success and adds value to the mine

"It would definitely help"; "It would be very helpful"; "Definitely, yes"; "Obviously"; "If knowledge transfer takes place, the mine will benefit" were some of the answers from the respondents to the question whether knowledge transfer would impact positively on project success. All of the respondents agreed with the statement.

S15: Mines are ignorant about the value-adding opportunities of knowledge transfer to new IPMs

Similar to the previous statement, there was overwhelming corroboration of this statement, with 78% of the respondents supporting it. To quote from one of the responses: *"We tend to make the same mistakes in projects over and over and over again"*. S15 was derived from Proposition 4, and the finding provided grounded support for it.

It should be noted that a few respondents commented that knowledge transfer would help IPMs to be more successful, but that it was not the most important factor: resistance to change and poor change management contributed more to IPM failure than the lack of knowledge transfer. According to one respondent: *"… obviously more knowledge will always make it [an IPM] more successful. But I don't think it's necessarily the biggest factor of success … Change management is probably one of the biggest ones for me"*.

S16: There are project management offices or other forms of project management support for IPMs on the mines

The response to this statement was unexpected: project management offices existed at five of the six mines considered in this survey. Their existence would certainly help the management of IPMs and, in the process, some formalised knowledge transfer could start to take place.

S17: Social media can be used to transfer lessons learned between IPMs

The use of social media for project management, and in particular for knowledge transfer, is still in its developing stage, but it is gaining ground fast. This was evident from 50% of the respondents supporting its use for the transfer of lessons learned.

The comments from those respondents who did not support the idea were that social media were too informal and that there was no control over what information gets transferred. The view of one respondent was this: *"I think WhatsApp and that sort of thing are useful for small things, but I would say in general it has limited application because it is too informal"*. Others maintained that, since social media platforms are open to senior management, there is a reluctance to share failures under lessons learned for fear of repercussions or negative perceptions that could limit their careers.

A criticism from one respondent was that social media can easily lead to an overload of non-essential information: *"So we are so loaded with WhatsApp groups, I mute most of them … because it's overloading of information and quite a lot of time overloading of rubbish"*. However, as software is developed for social media, more controls can be placed on the senders and receivers of data, as well as the type of data that can be transmitted. Social media have the potential to become a useful, practical, and convenient mechanism to transfer project knowledge – in particular, lessons learned.

S18: Informal communications can be used to transfer lessons learned

The respondents agreed that informal gatherings, discussions, meetings, etc. were used to communicate their experiences with IPMs and lessons learned. Some of the respondents felt quite strongly about the positive contribution of informal communication as a way to transfer information without fear of retribution. One respondent, a senior manager at one of the mines, commented: *"It is extremely important to communicate informally. Because there you meet different layers of people in the organisation … And so yes, so people share, people are approachable, they are approaching – so it's all-around engagement"*. During informal communication the barriers disappear, and people talk more freely about their experiences. Most lessons are learned through mistakes, and people are more willing to admit informally their mistakes and how they resolved them.

5.3. New insights

During the interviews, some new or alternative insights into the implementation of IPMs and the transfer of project knowledge were observed. Some of these were the promoters or inhibitors of knowledge transfer between IPMs.

Time constraints of operating personnel: Since IPM team members are sourced from the operating personnel on a mine (S6) and normally continue with their operational jobs and responsibilities, they are continually stretched, and do not have enough time to do all the work properly. This has a direct impact on the successful transfer of project knowledge (S12). Some related comments from the respondents were: *"Production people doing IPMs do not have the time, that's the main reason for not doing close-out reports and record[ing] lessons learned"*; *"IPM project managers are less successful, and no knowledge transfer* *takes place, because project managers have a day job as well"*; and *"Production personnel who do not have a full production job should be used to do projects"*.

Change management: As IPMs almost always have an impact on existing operations, change management is vital to ensure seamless integration and acceptance by the operational team as something that would enhance their operational performance. Change management is not done properly, mainly as a result of the time constraints imposed on the project team because of their operational responsibilities and the lack of experience in project management (S5) that prevails in most IPM teams.

People naturally do not want change unless they are convinced that the change will be to their benefit. This resistance-to-change factor was explained by one respondent thus: *"And the biggest thing is once people are negative against something, it's a problem because then they will find an excuse every time … to make sure it doesn't succeed"*. The correct change management process and its implementation are therefore fundamental to IPM success.

Collaboration platforms: Specific use of corporate collaboration platforms such as Microsoft Teams was shown to be useful. The comments by respondents about using collaboration platforms included these: *"On Microsoft Teams you can ask a question and is likely to get an answer, i.e., a different way to transfer lessons learned"*; *"Although informal, a community of practices on Microsoft Teams is used to record and pass on lessons learned"*; and *"At some mines, WhatsApp and Microsoft Teams are used to manage and control IPMs"*.

Other insights included that operations and IPMs are highly integrated and that the one always has an impact on the other. Operational controls are often used for IPMs. This means that project management functions that are required for IPMs can often be replaced by standard operational controls that are already in place, such as effectiveness and productivity measurements.

6. CONCLUSIONS AND RECOMMENDATIONS

This qualitative research provided grounded support for the stated propositions, and it also provided meaningful answers to the research questions. Following the findings from the data analysis, it was confirmed that the developed conceptual model was shown to apply to IPMs at mines; that the flow of knowledge and the transfer mechanisms that are used are largely controlled by the contextual factors in the outer circle of the model; but that, when knowledge reaches IPM teams, it is likely to enhance the chances of IPM success.

The research also indicated that a company culture that is conducive to communicating lessons learned and project failures without fear of retribution is essential. The use of social media and collaborative platforms should become more formal and promoted. As part of launching a new IPM, additional information should be provided, such as indicating how and where additional project information is available – including the lessons learned from previous or similar projects. Additional transfer mechanisms could also be investigated to transfer knowledge, some of which were mentioned by the respondents, such as a lessons-learned repository, standard operating procedures, project reports, review meetings, project launch sessions, expert consultants, site visits, and video conferencing.

From the research findings, some ideas could be suggested to the mines and their management that could enhance knowledge transfer between IPMs as well as the success of IPMs:

- Take note of the impact of contextual factors on the success of IPMs and on the transfer of knowledge between IPMs. The contextual factors discussed earlier included various factors that inhibit or promote the transfer of knowledge, the management and company strategies, and the operational environment within which IPMs are executed. The effective management of change in operations is a notable and important success factor for IPMs.
- Formalise the use of collaborative platforms (e.g., Microsoft Teams) for the transfer of lessons learned between IPMs. This could include the careful selection of group members, specifying the types of message that can be posted, appointing a 'group master' who regularly checks that the group functions as required, and expecting that group members visit the space regularly.

- Senior management should create a company culture of rewarding and promoting the reporting of failures that could provide learning material for others. In this way, the current perception that admitting failures in reports or social media would be detrimental to one's credibility in the company would be reduced and might even disappear.
- Senior management should give serious consideration to the workload of operating personnel who are also burdened with executing IPMs in addition to their normal day jobs. The overloading of people in middle and senior operational management positions is counterproductive, and leads to suboptimal performance on the operational side as well as by IPMs, thus not achieving their full potential in respect of operational improvements.
- Senior management should also consider establishing a 'sharing and caring' culture in which the use of quality circles and Kaizen is promoted as a way of identifying problems, investigating causes, and proposing solutions that could be implemented through IPMs. The new culture could help mines to share and spread best paractices, ideas, and lessons learned as part of a Yokoten process to standardise and sustain improvements.

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