

Alternative Approaches for Project Definition: An Application of Soft Systems Methodology

by

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Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of
Masters of Business Administration

in the
Executive Masters of Business Administration Program
of the
Beedie School of Business

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SIMON FRASER UNIVERSITY

Fall 2015

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Abstract

Large projects such as the transition of operations from one area of an open pit mine to a new area will involve the execution of a number of sub-projects. Existing systems at Teck Coal tend to emphasize the description and control of activities. The Soft Systems Methodology (SSM) is a process that can be applied to situations where resolution or improvement is required. The results of applying SSM to a specific sub-project indicate that it might successfully be applied more broadly and complement current practises at Teck Resources Ltd.

Keywords: project management, soft systems methodology, change management

Dedication

For Emma.

Acknowledgements

The author would like to thank Teck Resources Ltd. for the opportunity to pursue the MBA program.

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List of Acronyms

Term	Initial components of the term (examples are below)
bcm	Bank cubic meter.
COI	Communities of Interest.
CSR	Centre for Social Response.
EAC	Environmental Assessment Certificate
FRO	Fording River Operations.
mtcc	Metric tonnes of clean coal.
PDF	Project Development Framework.
RD	Root Definition.
SFU	Simon Fraser University.
SSM	Soft Systems Methodology.

Glossary

Term	Definition goes here, see example and notes below
Activity System	The series of logically linked purposeful actions.
Bank cubic meter	A cubic meter of rock in situ, i.e. un-blasted and without expansion due to blasting.
Clean coal	Coal that has been processed in the wash plant is ready for shipment and sale to steel mills.
Root Definition	A statement that describes the activity to be modelled.
PQR Formula	Defines basis of Root Definition. "Do P, by Q in order to achieve R"; P is 'what', Q is 'how' and R is 'why'.
Rich Pictures	A literal description of an account of a situation as a picture.
Senior Staff	Group of department superintendents

Chapter 1. Introduction

Large-scale mining projects generate change like few other endeavors. These projects require large footprints, an army of new employees and involve the construction of significant amounts of infrastructure. When people think about large mine development projects, they tend to think of new mines in the middle of nowhere; a type of homesteading adventure. It is a fact that large projects may happen throughout a mine's life. Resources in one mine area may become depleted, equipment or infrastructure ages, or new technology may become available. When appropriate, many mines will choose renewal by expanding mining areas and/or bringing on new, more modern infrastructure and equipment.

Teck Resources Ltd's Fording River Operations is embarking on its own renewal. The Swift Project will result in change for every employee at the operation as they eventually transition to that part of the mine. It will require money and resources, both of which are scarce. A project management team has been put in place to manage the transition. There is a large burden on the project management team to plan and execute the work that will enable the achievement of mine production targets.

One of the most important aspects of project management is the accuracy with which the transition work plans are defined. For all the subprojects, the end user will have expectations in terms of mode or performance. Poorly defined or executed projects

will cause delay and result in extra costs to the operation. Given the scarcity of capital, every effort to avoid re-work and delay must be taken.

Teck Resources Ltd (Teck) has developed a process to manage the conception and delivery of large scale projects known as the Project Development Framework (PDF). The primary function of the Project Development Framework is to provide the structure and governance to see through projects to a successful conclusion: the right project, within budget and on time. There are aspects of project management that are not covered by the PDF. It is important to continue to explore ideas and processes which may offer value to the overall project.

There is a body of literature that offers alternative approaches to problem definition beyond the 'problem statement' (Juan L. Cano, 2011) (Florian E Klonek, 2014) (Cooke-Davis, 2002) (Hayes, 2002). The Soft Systems Methodology is a multi-stage, easily applied process that is designed for the purpose of making sense of complex situations (M. Reza Mehregan et al., 2012) (Katsakiori Sgourou et al., 2012) (Neal, 1995). Among its attributes is the ability to reconcile the perceptions of the issue by different parties. It was applied to a subproject of the Swift Project to determine its ease-of-use as well as its effectiveness as a means of outlining a situation and suggesting a path forward. If successful, the rewards for better project definition and another pathway for engagement are large.

Chapter 2. Background

Teck is Canada's largest diversified resource company with its headquarters located in Vancouver, British Columbia. (Teck Resources Limited , 2014) Teck is organized into four strategic business units (SBUs) of which steelmaking coal is the largest by number of operations and number of employees. This SBU is known as Teck Coal. In recent years, primarily due to the price of coal, Teck Coal has returned higher revenue than the other SBUs. This situation has retracted somewhat since the decline in coal prices in 2014, however Teck Coal remains responsible for a significant portion of corporate revenues and registered approximately 31% of the gross profit, before depreciation for the year ending December 31, 2014. (Teck Resources Limited, 2015)

2.1. Site and Project

Fording River Operations (FRO) is a steel-making coal mine that has been in production since 1971. It is the largest mine in Teck Coal with the greatest annual production and employs approximately 1200 people. Since 1971, over 250 million metric tonnes of clean (processed) coal (Mmtcc) has been mined at the site. The operation is in need of additional permitted reserves that will sustain production beyond 2017.

The Swift Project (the Project) represents the next phase of large scale mining in the Elk Valley. Parts of the Swift Project area were mined by FRO until 1993. For the past twenty-two years, the area has been a legacy area, active only in terms of the

storage of seldom-used items. This area, though sparsely used now, represents the future of FRO. The Project will result in the addition of 170 Mmtcc to the permitted coal reserves and the Swift Project Team has been working for five years to develop an Environmental Assessment Certificate (EAC) Application.

Following the receipt of the EAC, Fording River Operations will need to move into the Swift Project footprint in an efficient manner. Near the end of 2016, production at FRO will transition from Eagle Mountain to the Swift Project footprint over a period of six years. The existing mining fleet of trucks, shovels, drills and support equipment - as well as all the personnel involved directly in operations – will transition to the Swift Project footprint. Assuming that other permits for smaller expansion projects on Eagle Mountain are received, by the end of 2023 FRO will be totally dependent on the Project area as a source of coal.

In the past six months, a project development team has been formalized. This team is responsible for developing all the work plans necessary for the shift of operations from Eagle Mountain to the Swift Project footprint. The team's overall objective is the management of the transition to "Swift" with no interruption to the production plan.

2.2. Teck Project Development Framework

In the last five years Teck has implemented a more structured approach for the development, approval and execution of large projects. This system is known as the Teck Project Development Framework (PDF). It is defined as "a set of related business processes that when applied together support development and delivery of improved

business capability and therefore business value through the effective management of projects.” (Teck Resources Limited, 2014, p. 1)

The objective of the PDF is “to satisfy two primary functions:

1. To support the organizations using the framework to deliver maximum business value from their projects through effective business ownership and holistic project management; and
2. To provide the organizational ability to assure the provision of such management and oversight to minimize the inherent risks each project faces and where necessary proposes corrective actions.” (Teck Resources Limited, 2014, p. 1)

2.3. The Challenge

Success for the Project will depend upon how well the transition work plans are defined, and on the accuracy and the diligence with which the plans are executed. Like many project management teams, the team is comprised of generalists with expertise in some topics, but who also lack detailed knowledge or experience in other subprojects they are expected to manage. For all the subprojects, the end user will have expectations in terms of mode or performance. Poorly defined or executed projects will cause delay and result in extra costs to the operation. Given the scarcity of capital and the tight timelines, every effort to avoid re-work and delay must be taken. The project team needs to find an effective tool for refining the scope of the various subprojects and getting agreement from the affected parties.

2.3.1. The Project and Change

The Swift Project is large in scope and wide in impact. Current cost estimates for the Project stand at over \$250 million. (Fording River Operations, 2015) The transition of the operation to the Swift Project will affect all six departments at FRO:

1. Mine Operations;
2. Mine Maintenance;
3. Processing;
4. Health and Safety;
5. Environment and Permitting; and
6. Human Resources.

The Project involves a number of sub-projects separated in a 'work breakdown structure.' The tasks and products of the tasks vary in extent and duration. (See Table 1, below.) Examples of the tasks are construction of roads and access from the new mining areas to the waste rock dump areas and erection of power lines that will supply mine equipment with power for operation. One of the other major tasks is to ensure that access to the Project footprint meets standards, is efficient and effective at moving personnel and equipment. The Project Team have been interacting with some staff in other departments for assistance in the preparation of plans for different aspects of the transition. The Project Team will rely on increased interfaces with Teck employees as well as consultants and contractors.

Table 1 Broad categorization of extent/duration of sub-projects with examples from the Swift Project

	Duration – Short	Duration – Long
Extent – Minor	Move boneyard	New access to radio tower
Extent – Wide	Annual recovery of topsoil	Construction of North Spoil

Given the critical nature of this change it is very important to explore any opportunity to improve the process by which it is managed. The two main components of project management – project definition and project execution – are the obvious areas to focus.

Chapter 3. Literature Review of Change Management

3.1. Change and Society

Alvin Toffler coined the term 'Future Shock' with the publication of his book of the same name in 1970 (Toffler, 1970). Future Shock refers to the state of disorientation an individual or group suffers as a result of change. When humans are unable to assimilate change they enter into a state of adaptive breakdown (Morton, 1973). It is similar to culture shock, the difference being that it is not possible to return to the previous state. People are order-makers and value security and routine. For this reason, most humans, when subjected to change, are on the look-out for ways in which to assimilate new and potentially dissonant realities with their current world view.

By seeking the means that allow people to impact and apply some control to the change that is occurring in their sphere of concern, the acceptance of the new means or places of working is made easier. Change management is an ordered program to assist humans in relating to and accepting change.

3.2. Change in Business

Businesses have attempted to become more flexible. They do this by hiring and training employees that are capable of adapting as needed. Employees are challenged to change (their roles, their expertise) as well as adapt systems or even implement

systems that are able to integrate change readily. The pace of change is not always consistent and it varies across industries. The pace and can exacerbate the difficulty of change.

With respect to stimulus, there are two types of change: anticipatory change and reactive change (Hayes, 2002). Anticipatory change is change made without an obvious external demand or stimulus. It is initiated from within as a renewal perhaps to develop a competitive advantage or in anticipation of a future change. Reactive change is done as a response to a clear and present need.

As discussed in Section 2.3.1, The Project and Change, the Swift Project is not going to result in a revolutionary change in the way FRO produces value: open pit mining employing a large truck and shovel fleet to release raw coal for processing in the plant. The change that needs to be addressed is ensuring that the transition to the area is smooth so that there is no interruption in value creation. The current planning for the Swift Project is in advance of the change and is anticipating the ways and means of the change which is preferable to a reactionary adjustment.

3.3. Change Management Theory

There are models that have been developed by various authors to outline the primary steps that are necessary to effectively execute change in an organization. Kotter writes about the eight steps to implementing change (Kotter, 2006):

1. Create a sense of urgency;
2. Form a powerful guiding coalition;
3. Create a vision;

4. Communicate the vision;
5. Empower others to act on the vision;
6. Plan for and create short-term wins;
7. Consolidate improvements to fuel more change; and
8. Institutionalize new approaches.

Kotter is a very influential writer on leadership and change in business. Bolman and Deal add some depth to the discussion of Kotter's change process by applying the four 'frames' that they discuss in their book Reframing Organizations: Artistry, Choice and Leadership (Bolman & Deal, 2008). The four frames constitute a series of mental models which a manager will use to decipher information coming to them and to make decisions. The manager needs to learn to apply the most appropriate point of view(s) to a situation. The four frames are: the structural, the human resources, the political and the symbolic frame. The names are helpful in providing information on what each frame stands for, as is Table 2, below which is meant to describe how each perspective would treat the different steps.

Bolman and Deal state that not all frames are necessary at each stage and Table 2, below includes some illustrations that are exaggerations in the context of business. "Public hangings" would potentially be firing or demoting a persistent opponent. (Bolman & Deal, 2008) The table helps to highlight that there are other needs beyond the mechanical implementation of a defined series of steps. In some instances the consideration of the alternative points of view is important for building consensus and mitigating risk.

Table 2 Reframing Kotter's Change Stages (Bolman and Deal, 2008, p.395)

Kotter's Stage of Change	Structural	Human Resource	Political	Symbolic
1. Sense of Urgency		Involve throughout organization;	Use power base	Tell a compelling story
2. Guiding team	New coordination strategy	Run team-building exercises	Stack team with key members	Put a commanding officer on team
3. Uplifting vision and strategy	Build implementation plan		Map political terrain; develop agenda	Craft a hopeful vision of future rooted
4. Communicate vision and strategy	Create structures to support change process	Hold meetings to communicate direction, get feedback	Build alliances; defuse opposition	Visible leadership involvement
5. Remove obstacles and empower people	Change procedures that support the old ways	Provide training, resources and support		Stage public hangings of counter-revolutionaries
6. Early wins	Plan for short-term victories		Invest to ensure early wins	Celebrate early signs of progress
7. Persistence	Keep people on plan			Hold revival meetings
8. New culture to support new ways	Align structure to new culture	Create a "culture" team; broad involvement in making culture		Mourn the past; celebrate heroes of the revolution; share stories of the journey

3.4. Change Management Process

In Community Relations or Economic Development parlance, the 'clients' are consulted for assistance in project definition. This helps to mitigate the risk of incorrectly scoping a project. The 'clients' are the Communities Of Interest, or COI's, and this approach could be adopted for the Swift Project. The COI's would be the six different departments listed previously in Section 2.3.1 above. Each department will have its own perspective and needs with respect to the change.

In order to manage the various needs of the COI's we can look to the Soft Systems Methodology (SSM) advanced by Peter Checkland. Checkland and other proponents promote SSM as a way to make sense of complex situations and bring forth multiple perspectives to define the most appropriate "purposeful activity" (Checkland & Poulter, 2006) (Juan L. Cano, 2011). The methodology also brings structure to the processes of analysis, debate and action (Mehregan et al., 2012)

SSM is a flexible process (acknowledging the complexity of an environment consisting of facts and perceptions of facts) that engages multiple actors making changes that are desirable and culturally feasible i.e. are within the parameters of an actor's worldview. The investigation starts with 'Rich Pictures' – literally, a picture of a problematic situation. From there, the practitioner develops a model of the actors, the cultural values and the politics that are at play. This information is added to the Rich Pictures throughout the course of investigation.

The next step is to create an organized process of enquiry and learning. A description of the 'Activity System' (a model) being undertaken is made from which the

practitioner seeks refinement by contrasting it with the real-world situation it models. The first description is the 'Root Definition'. The Root Definition (RD) is the basis from which the Customers, Actors, Transformation Process, Worldview, Owners and Environmental constraints (CATWOE) are articulated. The last step for the model-building is to define 'the three E's': efficacy, efficiency, and effectiveness. These criteria sharpen the thinking around the "purposeful activity".

The SSM does not provide any more details on the ways in which the project team would approach the specific owners, customers and actors when trying to refine the RD. This is where the work of The Centre for Social Response (CSR) might be applied. The focus of CSR is development work among poor and/or disenfranchised communities. However, they have also engaged with mining companies to improve the outreach capacity of the companies.

3.5. Change Management Practise

CSR's "People Centred Development" is a paradigm that frames the interaction of the person in service of development. The onus is on the outside party – in this case, the Swift Project Team – to engage and understand the needs of the COI's. CSR's handbook "Building the People Centred Approach" describes seventeen techniques in eight groups **Error! Reference source not found.** (Kelly & Burkett, 2010). These are listed in Table 3, below, and are presented in the eight groups of situations the practitioner might find themselves. In the case of the Swift Project Team, the Decision Making Techniques and Problem Solving Techniques will be most useful.

Table 3 CSR Problem Solving Technique Summary

Group	Group Name	Technique Name
1	Problem Solving Technique	Convergent Problem Solving
		Divergent Problem Solving
2	Networking Techniques	Networking
		Contradiction
3	Conflict Resolution Techniques	Third Party
		Mediation
		Structuring a Conflict Process
4	Communication Techniques	Cross Cultural
5	Decision Making Techniques	Community Planning
		Optional Proportional Voting
6	Research Techniques	Community Reconnaissance
		Community Surveying
		Participatory Research
7	Education Techniques	Demonstration
		5WH
8	Analysis Techniques	Network Analysis
		Gender Analysis for Projects

The foundation is a strong technical ability for dialogue that serves to learn and then address areas of development. The work of the Swift Project Team will mainly fall into the Decision Making Group which is suited for a context in which there are the needs and the resources to meet the needs.

The purpose of the Decision Making Technique in CSR terms is to orchestrate public action. The central behaviours identified under this technique are outlined in Table 4 below. These are referred to as the steps necessary in Community Planning, however they would do well in a campaign of project management and they offer that first step in needs identification.

Table 4 Steps in Community Planning

Central Behaviour	Specific Behaviour
Name the type of need	Norm, Compare, Express
List the stakeholders	Circulate
Analyse the context	SWOT
Gather and focus energy	Invite, Lobby, Consult
Set the goal	Clarify, Prioritise
Plan the strategy	Resource, Task, Delegate
Regroup and review progress	Pause, Reflect, Critique

3.6. Change Management at Teck

Based upon the work of CSR, Teck has developed a community engagement tool known as the SMART Framework. This is being rolled out to the staff who are involved within the community engagement roles. Within the larger framework of change management, Teck is developing an in-house strategy for mapping impacts of change and planning the communication, training and/or support mechanisms to ensure the goals of the planned change or solution are met and all the benefits to the business are realized. Professionals involved in large projects are being introduced to these concepts and tools.

In terms of a change management process, the SSM methodology appears to offer a substantial benefit for the purpose of defining subprojects. It has been used on many scales and across a number of industries and is considered a mature method.

Chapter 4. Research Objectives and Methodology

4.1. Soft Systems Methodology Application Objectives

The first account of Soft Systems Methodology was published in 1972 and the method has been refined and retold many times since then. (Checkland & Poulter, 2006) Applications have also been many and various. In terms of an organized method of defining and taking action to improve problematical situations, it has proven its effectiveness.

The techniques of SSM are different than those identified in the PDF and the Teck Change Management practices. By applying the SSM to one of the subprojects of the Swift Project it will be possible to get a feel for the process and an indication whether SSM may prove to be an effective method. A qualitative assessment of its effectiveness will be conducted. This assessment will be done by the Swift Project Team to determine if SSM should be trialled further to discover if it is suitable for recommendation to other project managers in Teck and to the corporate project management group for inclusion in the overall PDF.

The Soft Systems Methodology will be evaluated against two questions:

1. the success of SSM in assisting in the definition of a project for the Swift Project Team; and

2. The success of SSM in achieving a decision on the advance of a project as defined.

The authors of SSM insist that people who take part in the application of SSM learn more from modelling actual situations than those that just read about it. There are training programs for people with a deeper interest, but it is possible to use the available literature to begin to experiment with its techniques. (Checkland & Poulter, 2006) In the early stages of knowledge, it is pointed out by Checkland and Poulter in the same work that the application of SSM will be a little more mechanistic than that of the experienced practitioner, but that is the case in many endeavors and is to be expected. Observations of the interveners will also form part of the evaluation.

4.2. Research Plan

The methods and order of the application of the different techniques will follow those described in Checkland and Poulter (2006). The format of the analysis will more specifically follow the process used by Mehregan (Mehregan et al., 2012) The process is comprised of seven steps that are described below.

4.2.1. Soft Systems Application Method

The subproject to be used in the study is the Powerline Crossing Project. A meeting with the Owners of the Powerline Crossing is scheduled for mid-June. The Powerline Crossing project was only identified in early April and therefore is relatively new for the Owners and has not had any previous project description. Since April, the Swift Project Team has interacted with field personnel and senior staff on an irregular

basis while determining options for “action to improve” and it is clear that there is no obvious solution for which consensus is easily achieved.

The SSM learning cycle begins with discovery. After describing the situation with a ‘Root Definition’ (RD), there are four ways of finding out about a problematical situation:

- making Rich Pictures;
- carrying out Analysis One: nature of intervention;
- Analysis Two: social, cultural; and
- Analysis Three: power, political.

For the subproject selected for SSM, the three analyses will be applied. The products of these analyses represent a model of an ‘activity system’ in time that becomes a basis for asking questions in order to refine the understanding around the real-world situation. They put in order one way of looking at a more complex reality.

It is important to make plain the perspective or Worldview from which the activity system is modelled. A fulsome RD is necessary to do this and SSM provides a formula for doing this. The ‘PQR formula’ will be utilized to build an RD for the Shovel Crossing Project. Other elements of the RD include the identification of the ‘Customers’, Actors, Owners and Environmental constraints as well as the Transformation process. (The mnemonic ‘CATWOE’ helps to remember the various properties mentioned above and will be familiar to some systems practitioners.)

From the Root Definition a 'Purposeful Activity Model' is also generated complete with a monitoring and control plan. The criterion for the measurement of performance is also outlined as the Three E's: Efficacy, Efficiency and Effectiveness. These can be modified as understanding of the problematic situation deepens but for the purposes of research, this will not likely occur given the timelines. Around each measurement criterion, evaluative tests must be set up prior to the real world situation playing out.

In the parlance of SSM, it should be determined if the Root Definition is a 'Primary Task' or an 'Issue-based' definition. The subprojects of the Swift Project, as described above, tend to cut across the Fording River Operations organization and therefore would fit into the category of 'Issue-based' RD's. These definitions tend to attract a lot more attention due to the political implications. It is suggested that practitioners do not work exclusively with Issue-based or Primary Tasks exclusively; a mixture works better. (Checkland & Poulter, 2006)

Once the Rich Pictures are in place and the analyses complete, a richer appreciation of the situation is possible and may help in the development of 'Actions to Improve'. These tools and models are to be used in discussions with the Owners to help structure the dialogue. There is a host of things that may manifest during such a discussion, so during such meetings notes around the discussions are captured as part of the findings.

In the case of the Swift Project, several options for Actions to Improve have already been identified. Each option will be subject to the analysis with its own conceptual 'activity system' model. The model will be evaluated according to its perceived ability to meet the Three E's criterion.

Information on the performance of each activity system based on the criterion will be presented to the project owners. During the meeting, the questions around the modelled activities will be recorded. The detailed information needed to clarify the modeled activity system will be assigned to a project engineer or other suitable role. If it is possible to narrow the options being considered or reach a conclusion on the preferred activity system then the decisions will be recorded.

4.2.2. Introduction of SSM

For the meetings of the various Owners, the introduction of SSM will be done in a measured way. The Soft Systems Methodology is new to FRO, so an approach advocated by the practitioners is to have the models available if needed and to bring them in when appropriate.

4.3. Measures of Success

The application of SSM will be determined to be successful if the following occurs:

1. It is possible to follow the steps exhibited in the Mehregan, et al (2012). paper;
2. Other parties familiar with the project are able to follow the logic laid out in the Rich Picture and the modelled Activity Systems; and
3. A conclusion can be reached based on the three options presented at a meeting of the stakeholders.

Chapter 5. Results of the Soft Systems Methodology Study

In the case of this study, the practitioner has not had the opportunity to study SSM in great depth. A more seasoned practitioner will undoubtedly find errors in the approach or find the application a gross simplification in the whole. It is hoped that the findings here are not found to be unforgivably specious.

The fact that three Activity Systems were modelled was found to be somewhat unique in the literature. The options were the result of previous investigations, inquiry and interviews. In their guide, Checkland and Poulter (2006) advise that the models stay very general. In the case of the Powerline Crossing Project, the three options were represented as generally as possible.

5.1. Soft Systems Methodology in Practise

The study performed in May and June of 2015 is found in Appendix A. The three options were reviewed by the Owners during a decision meeting called for by members of the Swift Project Team.

5.1.1. Rich Picture

During the creation of the Rich Pictures, a certain amount of iteration was needed to satisfactorily (in the creator's mind) represent the viewpoints of the affected

parties. It would then seem to suggest that the exercise of drawing the Rich Picture is best done in the company of others familiar with the situation. The Rich Pictures were reviewed by the staff of the Project Management Team to get their feedback. Feedback was overall positive and some productive conversations resulted. The picture helped to provoke some additional thinking and further questions about the challenges, real and perhaps only perceived.

This step at the beginning helps to set up the definition of the situation at hand. However, just as the creators of SSM suggests, its real use is in forestalling the use of written or spoken language that can often lead to confusion as individuals' perceptions can bias meaning to the point where each party may go away thinking they understand the situation but may have made entirely different interpretations.

Under current practises, the problem statement is made right at the front end by the project engineer. Instead, the Rich Picture is discussed and is used to formulate the Root Definition.

5.1.2. Root Definition

The creation of the Activity System models that represented each of the three options was a practise of explicitly stating the actions to achieve the desired outcome. The practise of expressing the Root Definition to allow for a number of possible alternatives was a challenging one. Many individuals in the engineering field tend to be natural problem solvers and as they begin to encounter a problematic situation, solutions being to form in their heads. It requires deliberate effort to avoid pre-supposing the answer and the payoff of doing so inly becomes obvious later.

Once formed, the RD was found to be an essential component in terms of weighing the validity of the possible solutions. However, it was found that having the standards in the sentence (“... that satisfies FRO’s standards in terms of safety and cost-effectiveness in order to meet FRO production goals”) helped to focus the thinking of the practitioner. It was also a useful touchstone during the meeting. Have safety standards in place is a helpful constraint in the sense that some activities can be ruled out immediately.

5.1.3. Activity System Models

During the creation of the models, it was an interesting exercise to refrain from detail. Each of the activities represents a lot of other specific actions and there are some rabbit-holes that can draw in a writer’s time and effort. As indicated by the authors of SSM, staying at a high level for as long as possible will avoid the tendency to rush down the first set of activities that result in an improvement instead of finding the best approach possible under given circumstances.

The method was fascinating for its novelty and it was surprising to the practitioner that it produced such concrete results considering its relatively esoteric form.

5.2. Findings

The overall results of the practise of SSM in this case were found satisfactory. Each of the three measures of success defined in Section 4.3 was met. The methodology was helpful in fostering discourse and ideas and was able bring forth key changes. The literature (Huaxia, 2009) (Mehregan et al., 2012) talks of its value in

facilitating negotiations due to its ability to bring forward the concerned stakeholders and give people a chance to narrow in on the actual situation and see that others have points of view and what they are. With some discussions with communities of interest on the actual process, there is potential for further application and broadening of its impact in the fields of engagement and collaboration.

Chapter 6. Conclusion

The Swift Project is a large, multi-faceted project that represents a significant transition for the operations and the workforce at Fording River Operations. With any large change there is risk. There are many large and small projects that need to be executed to affect the transition from the current mining area to the Swift Project footprint. One of the risks is that the work that needs to be done remains poorly defined. The inclusion of key individuals in the definition of sub-projects as well as being able to draw them in on the execution at FRO will mitigate the risk. The move to the Swift mining area is very important to Fording River Operations and Teck Coal and warrants the examination of other methods to reduce the risk.

The Soft Systems Methodology developed by Peter Checkland is a systematic approach to challenges of transition. It is an intentional process that identifies the people involved and efficiently consults them in the definition of the action to be taken. The method consists of a unique method of inquiry aimed to build a conceptual model of the current situation from which it is possible to draw out the most appropriate activities based on accommodation by the affected parties. This system is a departure from current processes being deployed, but may address some aspects of project definition not otherwise covered.

In order to test the process, a sub-project from the Swift Project work plan was selected for examination. In this particular example three options had already been

identified. Prior to the use of Soft Systems Methodology it was proving difficult to settle on a final decision. Leaning on the large amount of literature on the technique and its use made the application of the method relatively simple. Among the findings, the method readily assisted in the articulation of the benefits and disadvantages, was useful in identifying the stakeholders and distinguishing the information needed to make an informed decision. In terms of recommending one of the three options, confidence was greatly increased. The critical examination of the three options by the key stakeholders quickly led to a decision on the path forward, further proving its utility.

By looking within our industry as well as beyond, the Project Team is likely to be able to develop tools that will improve the success of the Swift Project as well as add to the Project Development Framework more recently implemented in Teck. SSM is a method that was found to be helpful. The approach of characterizing the entire situation and the method of driving questions to help develop resolution were intriguing. Allied with the monitoring and control process, it proved to move the situation forward. The built-in consultation is also seen as a benefit and as the project advances, having reached out the affected parties, should facilitate the selected action(s).

In order to be able to recommend this as part of the Teck approach to project management, application will be made to more projects to refine the skill. Other practitioners will also be sought out to find other examples, tips and lessons. SSM holds strong promise to improve the way in which 'problematic situations' are improved.

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Appendix A.

Soft Systems Methodology – Powerline Crossing

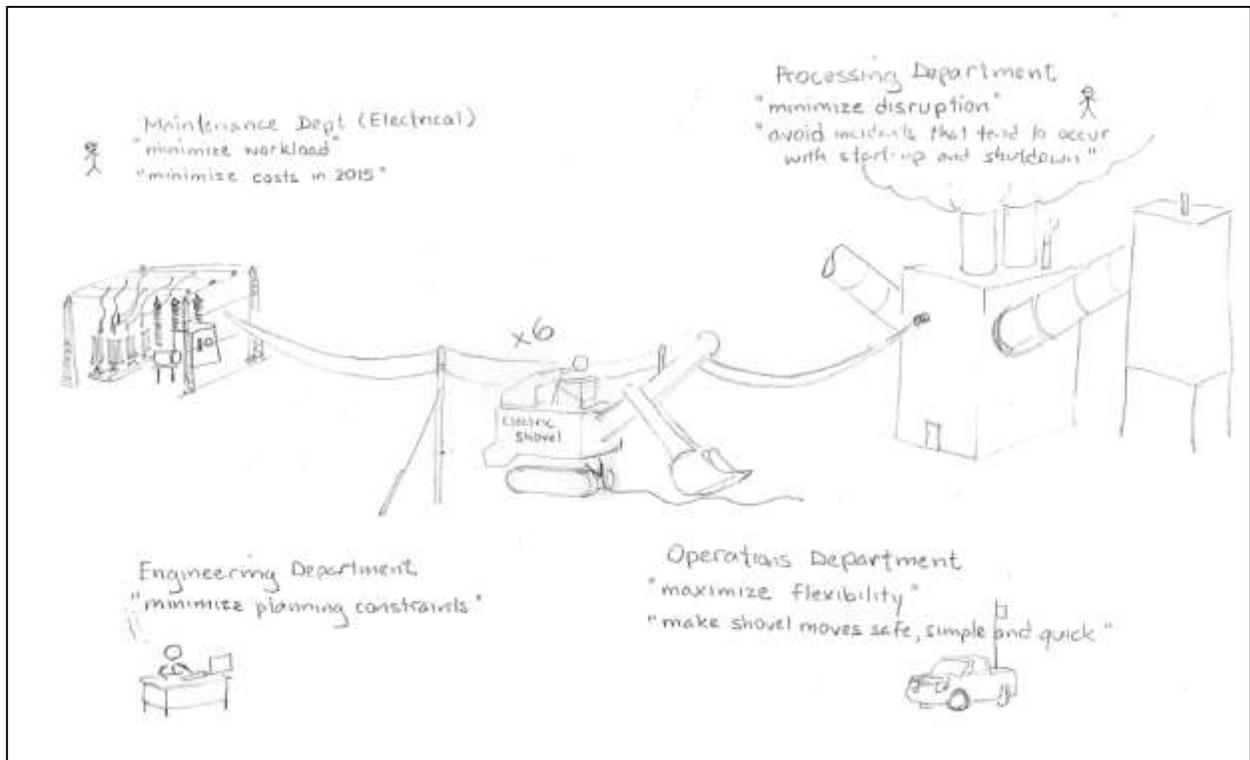
Based on evaluation done by M. Reza Mehregan, et al (Mehregan et al., 2012).

Step 1: Gathering information on problematical situation

Problematical Situation: On the only viable shovel walk route between Eagle Mountain and the Swift Project there are a series of powerlines. The space between existing powerlines and road is less than the approved standard for the passing of the current shovel fleet. Passage of shovel in any scenario requires shutdown of power to major site facilities. There are six shovel moves planned in the next six years.

Step 2: Displaying Problematical Situation in Rich Picture format

Figure A1. Rich Picture of Shovel Crossing Situation



Step 3: Formulating Root Definition, conducting analyses

Defining P, Q and R in order to use PQR formula for Root Definition. In this situation:

- P: Move a shovel from Eagle Mountain to the Swift Project;
- Q: in the safest and most cost-effective manner; and
- R: Shovel needed for production in Swift Project area.
- Specific Constraint: Powerline Cluster at Sunshine Power

RD: “To achieve the movement of shovels from the current active mining area to the Swift Project area by creating passage by the powerline cluster that satisfies FRO’s standards in terms of safety and cost-effectiveness in order to meet FRO production goals.”

- Client: Operations
- Practitioner: Swift Project Team
- Concerned/Affected by Change: Maintenance (electrical), Processing, Engineering, Operations, Swift Project Team (SSM(process) and (content))

Analysis One - Intervention

Looking at potential intervention from the point of view by all those affected.

Table A1 CATWOE Elements for shovel move, includes perspectives of concerned parties

CATWOE	Maintenance	Processing	Engineering	Operations	Project Team
Clients	Operations, Maintenance, Processing	Processing	Engineering, Operations	Operations, Engineering	Operations, Maintenance, Engineering
Actors	Maintenance (electrical), Project Team, Operations	Maintenance (electrical)	Maintenance (electrical)	Maintenance (electrical)	Maintenance (electrical), Project Team
Transformation	Approval from C about T, Manage and perform T	T done by Mtce, T to be well communicated	T done by Mtce, T to be well communicated, T to be responsive to mine plan	T done by Mtce, T to be well communicated, T to be responsive to mine plan	Initiate and coordinate T, Plan and track cost of T, communicate T
Worldview	T should satisfy needs of other C, minimize scope of work	T to minimize disruption	T to eliminate or minimize constraints	T to eliminate or minimize effort	T is acceptable to C, within budget
Owners	Mtce (electrical)	Mtce (electrical)	Mtce (electrical)	Mtce (electrical)	Mtce (electrical), Project Team
Environmental Constraints	Limited workforce, need to blackout parts of site	Blackout to plant	Blackout to mining areas	Blackout to mining areas, shovel moves involve extra workforce	Limited opportunities for full blackout

Analysis Two – Social

Roles (formal): Superintendents, Senior Engineer, Engineer, General Foreman, Foreman, Lineman, Project Manager

Norms: Hierarchical, purposeful, direct, responsibilities and domains well defined

Values: Safety, cost-conscious, sensitive to limited resources and workforce constraints

Analysis Three – Political

Power is won by being decisive, organized and efficient, innovative, achieving and exceeding targets

Power is represented by roles in hierarchy, persuasiveness (charisma, talent, and innovation), kinship

Power is exercised by role and delegation, offering or withholding resources (equipment, workforce, budget)

Step 4: Building conceptual model

Conceptual model is intended to identify main purposeful activities based on the Root Definition. In the case of the RD, three interventions are being evaluated to determine the most satisfactory Action to Improve. For the affected parties, the Action to Improve must meet the evaluative criteria and be consistent with their Worldview.

Purposeful Activity Model

Three purposeful activity models are prepared (see below); one for each option.

In order to evaluate each model, the Three E's – Efficacy, Efficiency and Effectiveness – need to be defined. Under the Three E's, the following questions are posed:

E₁ Efficacy: what is the most effective way of achieving safe shovel moves? What is the most effective way of creating passage for the shovel?

E₂ Efficiency: what is the most efficient way of moving the shovel? What is the most efficient way to create passage for shovel?

E₃ Effectiveness: what is the most effective way of moving the shovel? What is the most effective way of creating passage for the shovels?

Monitoring and control for the three models proposed should provide feedback on the performance of the Purposeful Activity against the Three E's. For each option, the following is to be measured:

1. Time required to execute the task, i.e. measure the length of shutdown for selected case as well as evaluate of the crossing resulted in unforeseen production delays.
2. The amount of resources required. This is constituted by the number of hours worked (FRO employees and contractors). Measure total costs.
3. The safety of each activity. A risk assessment should be completed for each activity and, if necessary, (if there is contention) evaluated by the superintendents. A post-activity evaluation should take place to determine if the work conformed to predicted hazards and met expectations in terms of worker security.

The Three E's were formatted in a table and looked at from the perspective of the primary client (Operations) as well as the primary actor (Maintenance (electrical)) below.

Table A2 Three E's for shovel moves, powerline realignment

Criteria	Shovel Move	Powerline Cluster
E1 – Efficacy	Flexibility with respect to timing through cluster	Amount of time to create first passage, all shovel moves
E2 - Efficiency	Amount of time and resources required to pass cluster	Amount of time and resources to facilitate passage of shovel
E3 - Effectiveness	Meet production goals, meet safety standards and expectations	Safe passage of shovel with acceptable risk to people and facilities involved

Monitoring and control for the three models proposed should provide feedback on the performance of the Purposeful Activity against the Three E's. For each option, the following is to be measured:

1. Time required to execute the task, i.e. measure the length of shutdown for selected case as well as evaluate of the crossing resulted in unforeseen production delays.
2. The amount of resources required. This is constituted by the number of hours worked (FRO employees and contractors). Measure total costs.
3. The safety of each activity. A risk assessment should be completed for each activity and, if necessary, (if there is contention) evaluated by the superintendents. A post-activity evaluation should take place to determine if the work conformed to predicted hazards and met expectations in terms of worker security.

Figure A2 Option 1 – Raise poles on 1 side of road

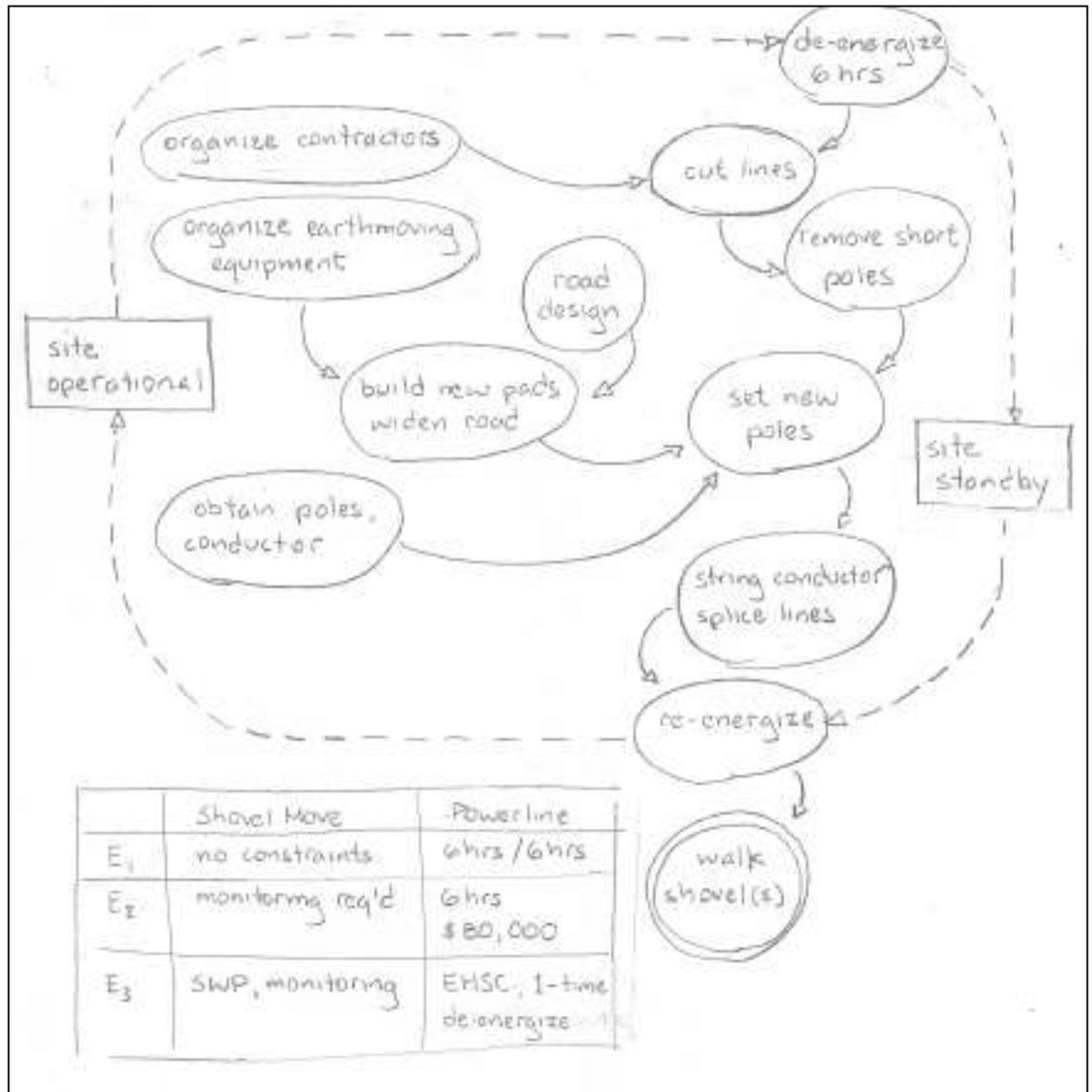


Figure A3 Option 2 – Raise poles on both sides of road

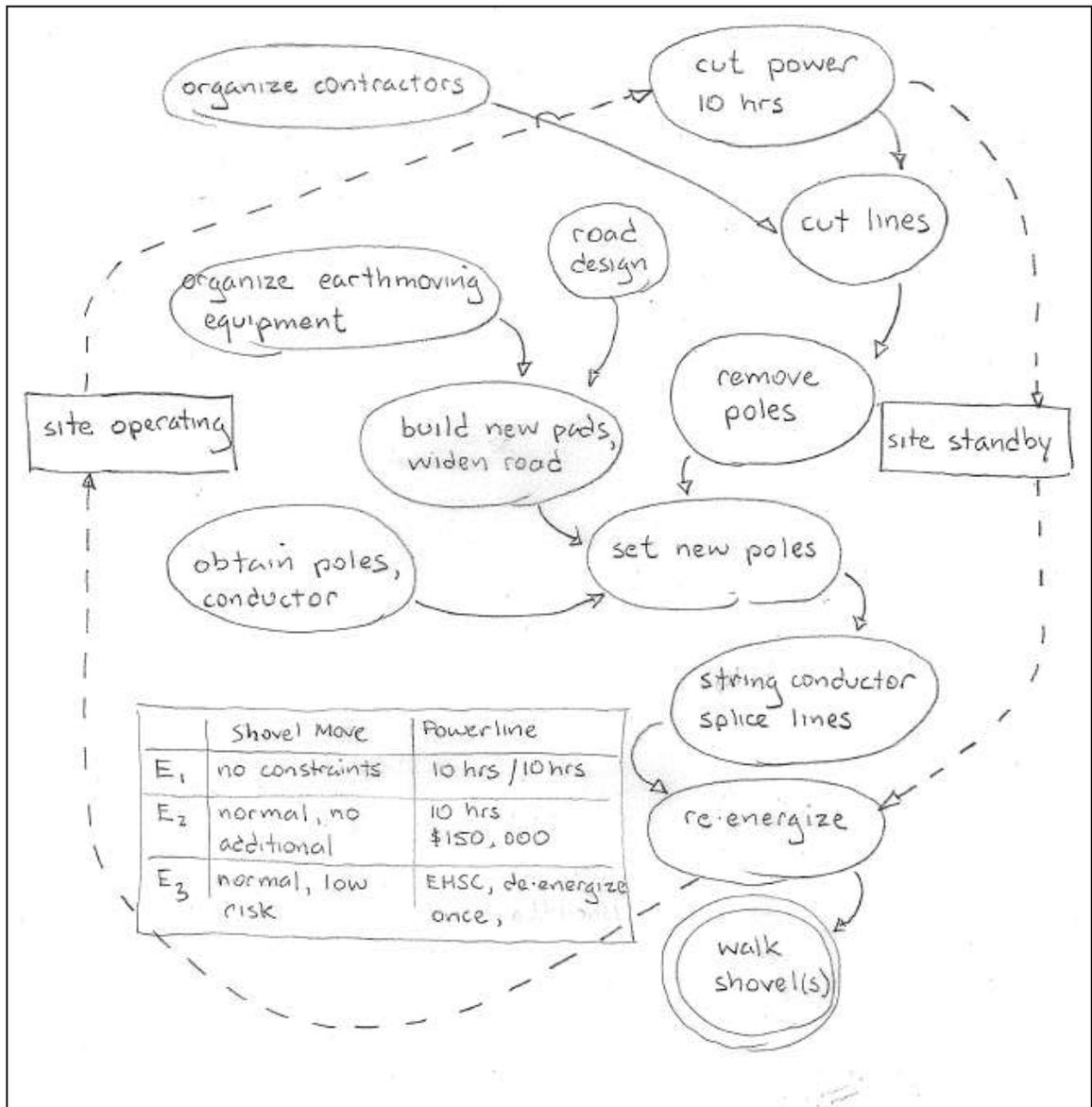
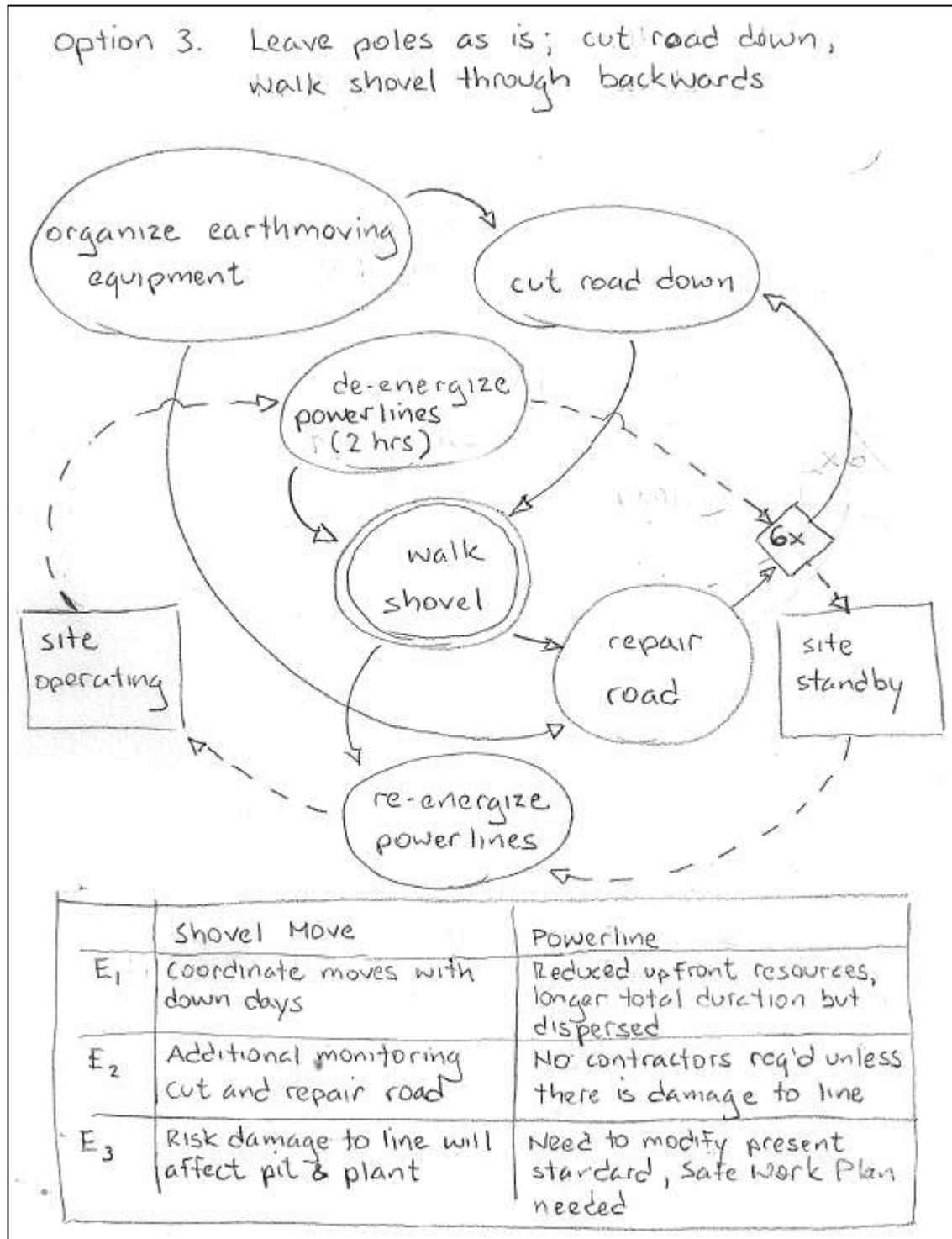


Figure A4 Option 3 – Leave poles, cut road and walk shovel through backwards



Step 5: Evaluate the model against the real world case

The simplified models are built according to a perceived logical action plan based on a number of assumptions. Examples of questions to be satisfied before the models can be considered accurate and precise prototypes for action.

Test questions:

1. Does changing poles enable road widening? Does road need widening?
2. Are more contractors required for 2-side raise than 1-side raise?
3. Does raising one side achieve height needed? (Draw diagram with estimated sag.)
4. How long does it take shovel to walk from breaker to Lee's Lake? Is two hours accurate?
5. One line at breaker, the remainder at Sunshine; is it possible, is there a benefit to energizing lines while the shovel walks from the line at the breaker to Sunshine?
6. The first line at the breaker is on a ramp. Is it possible to cut the road down on the ramp at the breaker?
7. Verify the number of shovels over the entire Swift Project mine plan.
8. Are there other important heights on the shovel apart from the point sheave?

Step 6: Identification of practicable and culturally feasible preferences for changes to access to the Swift Project that resolves the Problematical Situation now.

A meeting was held with the superintendents of all the departments that are affected by the change, as well as the Health Safety Department Superintendent. After the three options were presented it was decided to proceed

Step 7: Finalize option with superintendents and execute Action to Improve.

A meeting was arranged on the 18th of June, 2015 for the purposes of reviewing the options. During the meeting the options were presented. Based on the models and estimates of the impacts of each Action to Improve option, the superintendents elected to raise the powerlines on one side of the road. In order to mitigate the impact of de-energizing the various systems, it was decided that the project will take place on a planned site blackout in September 2015.