

Article

An Application of Soft Systems Methodology in the Sugar Industry

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Abstract

This research describes and analyses a methodological approach, known as Soft Systems Methodology (SSM). SSM was applied in the sugar industry, which is characterized by diverse stakeholders who have multiple and often competing objectives. SSM is a methodology that was developed in response to the limitations of the systems engineering approach. It uses a flexible, yet organized process to bring about action to improve problematical situations. A qualitative research approach was used. Interviews and SSM workshops were held with growers and the miller, and other stakeholders. Interviews were conducted with the focus on identifying the goals of the various stakeholders in the mill area, and how communication, trust, and overall efficiency were perceived by the stakeholder groups, on their own and as a whole. Data were analyzed using thematic analysis. Purposeful activity models were created after an analysis of the interview transcripts, and rich pictures were constructed by stakeholders in a SSM workshop. Stakeholders were invited to a second SSM workshop where they were presented with SSM tools that were constructed. Participants then chose to work on a model and engaged in debate about how the model compared to the real world, and considered how to take action to bring about improvement. The research illustrated the value of applying SSM in the sugar industry by bringing together diverse stakeholders to identify and address the multiple perspectives held about the overlapping problems. Through the SSM process, various problematic aspects of the sugar industry were uncovered and presented to stakeholders to bring about action. SSM facilitated the identification of the various objectives that the stakeholder groups were individually pursuing, and also created space for discussions into how to jointly create a desired future that could benefit all stakeholders. This collaborative methodology enabled meaningful and systemic interaction between the researcher and participants, by providing an opportunity for

respondents to share their multiple and valid perspectives about the problems, challenges and opportunities in the mill area. Through the use of the SSM tools, further insight was gained into the roles, goals, values, power, and culture of the study context.

Keywords: sugar industry, Soft Systems Methodology, SSM, qualitative research

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Research into the sugar industry has placed emphasis on the relationships between stakeholders, particularly those of growers and millers (Hildebrand, 2002; Masuku & Kirsten, 2003; Wynne, 2009). Although the appearance of sugar on the shelf is taken for granted, complex interaction is required between multiple stakeholders, who separately pursue different objectives and activities, to eventually realize the final product. Given this inherent complexity, the multiple stakeholders often hold different views on what precisely the multifaceted problems in the sugar industry are and how best to address them. Relevant tools and methodologies are therefore required to allow stakeholders to jointly identify, contemplate, and address the issues facing the sugar industry, which may not only be of a technical nature. The aim of this research was to explain, illustrate, and critique Soft Systems Methodology (SSM) by drawing on lessons from its application in the sugar industry. The research took place in a mill area in a developing country context, characterized by diverse stakeholders who pursue multiple and often competing objectives. The mill area will not be revealed due to confidentiality agreements.

SSM has not yet been applied in the sugar industry; therefore, this was an exploratory study. Reid et al. (1999) used SSM in the New Zealand dairy industry where there are also various interdependent component parts, operating to achieve diverse goals, and parties that hold different perspectives on issues facing the industry, thereby making it difficult for people to work together.

Soft Systems Methodology (SSM)

SSM was developed in response to the limitations of the systems engineering approach, which was considered deficient in dealing with the social complexity pertaining to human situations (Checkland & Poulter, 2006). The systems engineering approach tends to neglect worldviews and perceives a system as something in the world that can be engineered with exact objectives (Checkland & Poulter, 2006). Systems engineering is classified as a hard-systems methodology, whereas SSM focuses on learning and not on the design of a solution (Khisty, 1995).

SSM is a mature, rigorous, well-established methodology, which has been used in a variety of contexts, disciplines, and countries, and which relies on resilient principles (Checkland & Poulter, 2006; Jackson, 2003). SSM is a qualitative research methodology, which is based on action research and systems thinking theory, and which places importance on meaning, self-reflexivity, interpretation, human experience, learning, and participation (Jackson, 2003; Salner, 1999). Checkland and Poulter (2006) clearly point to a shift from positivism and functionalism, which they consider the “hard” approach, to phenomenology and interpretive sociology, or the “soft” approach. The term “soft” in SSM is a problematic word in qualitative inquiry, and does not imply that this research is in any way less significant than “hard” science. What does however come across is that these problems, which are also known as “wicked” problems, can be challenging to investigate and comprehend due to the social and political aspects of the situation, as pointed out by Kayaga (2008). These problems evolve, are socially complex and are not easy to define, contain many interdependencies, can result in unintended consequences, and often do not have clear solutions (Australian Public Service Commission, 2007). This is in contrast to “hard” problems, which can easily be predicted, whereas the interactions of people introduce complexity (Brenton, 2007). It is thus critical to have robust methods to investigate such problems.

The interpretive paradigm, wherein SSM is located, acknowledges how such systems are better understood through gaining a subjective perspective of the views and meanings of those involved (Jackson, 2000). This indicates the importance of considering how social reality is constructed and reconstructed through conversations and actions, as opposed to a pure static outlook on social reality, which neglects worldviews (Checkland, 2000; Checkland & Poulter, 2006).

SSM can be applied in any real-world situation where people act purposefully (Checkland & Poulter, 2006). Reference is made to “problem situations” as opposed to “problems” because

there will always be a plethora of problems and multiple perspectives present in a situation (Luckett & Grossenbacher, 2003). SSM uses a flexible, action-oriented and organized process to bring about improvement to problematical situations (Checkland & Poulter, 2006). SSM is therefore ideal to apply in situations with “messy, ill-structured, real-world problems” (Khisty, 1995, p. 97).

SSM originally consisted of seven stages, which are now compressed to four main stages. The SSM process commences by exploring the problematical situation through identifying the issues, as well as analyzing the culture and power relations (Checkland & Poulter, 2006). Rich pictures can be used to express the situation by depicting the stakeholders and the problems that they experience pertaining to workings between stakeholders, as well as interconnections and relationships between the actors (Kayaga, 2008; Khisty, 1995).

The second stage of SSM consists of constructing relevant purposeful activity models, which correspond to a specific worldview. Root definitions, which outline the core purpose of the activity system to be modeled, are constructed (Checkland & Poulter, 2006). The PQR formula is used to populate the root definition, and sets out purposeful activity as a transformation. The P is the *what*, Q the *how*, and the R, the *why*, or as Checkland and Poulter describe, “do P, by Q, in order to help achieve R” (2006, p. 39).

A general model of purposeful activity, known as the CATWOE is then created, and is outlined below (Checkland & Poulter, 2006):

- C for the Customers who are beneficiaries or victims.
- A for the Actors who are responsible for the activities.
- T for the Transformation.
- W for the Worldview.
- O for the Owners who can prevent or change the activity.
- E for the environmental constraints.

Conceptual models are then created from the root definitions, the PQR formula, and the CATWOE. A “system” in SSM terminology refers to the conceptual models that illustrate the ideal set of activities required for a necessary transformation, and not actual reality (Luckett & Grossenbacher, 2003). The models are then used to structure debate about the situation, which forms the third phase of the SSM process (Checkland & Poulter, 2006). Dialogue occurs as stakeholders compare the real world with the models.

The final stage in the SSM process consists of defining and implementing necessary actions with the aim of identifying desirable and culturally feasible changes. Checkland and Poulter (2006) argued that the changes have to appeal to the people in the situation, taking into account their unique history and worldviews.

Methodology

The qualitative research approach was used in this research. Ethical clearance for the study was obtained. Permission was obtained from the participating institutions, which supplied gatekeeper letters that were then used to acquire ethical clearance approval from the university. All respondents received an informed consent form detailing the aim of the study, as well as assurance that their participation was voluntary, that what they said would be confidential, and that they could withdraw from the project at any stage should they so desire. Fieldwork comprised of interviews and SSM workshops. Various stakeholders in the mill area, including the growers, miller, hauliers, Sugar Research Unit, and National Sugar Association, were involved in the research.

Semi-structured, face-to-face interviews of approximately one hour, were conducted in the mill area. Unstructured, open-ended questions were constructed to allow for the emergence of rich descriptions and stakeholder perspectives. The interviews provided a platform for stakeholders to openly express their views in a safe environment.

Interviews were conducted from 13–15 July 2010 to gain an initial understanding into the soft issues (communication, leadership, overall efficiency, trust, and goals) that exist in the mill area. Twelve interviews were conducted with six growers, three representatives from the mill, one haulier, and representatives from the local grower body and National Sugar Association. All interviews were digitally recorded and transcribed.

Two SSM workshops took place in the mill area, and each one lasted approximately half a day. Invitations were sent out to all stakeholders in the mill area to allow for diverse input. The workshops were facilitatory in nature, with the researcher taking the lead in engaging the participants in discussions. The SSM workshops, as with the interviews, were aimed at allowing stakeholders to build momentum through identifying the issues regarding cane supply, cane quality, transport, conflicting goals and communication, and eventually taking action to address these issues.

The first SSM workshop occurred on 22 September 2010 with eight participants. In this workshop participants engaged in the construction of rich pictures. Two growers, three representatives from the mill, one haulier, and two representatives from the National Sugar Association and the Sugar Research Unit, respectively, participated in the workshop.

A second SSM workshop, which was held on 27 October 2010, was organized with the purpose of presenting the SSM models to the stakeholders and having them interrogate and take forward what they considered valuable. This workshop was attended by three mill representatives and eight growers.

Data from the SSM workshops and interviews were continuously analyzed using thematic analysis.

Results

Problem Situation

The unstructured problem situation was examined by conducting interviews to gain an initial understanding into the soft issues (i.e., communication, leadership, overall efficiency, trust, and goals). Brenton (2007) argues that this first phase of SSM is aimed at experiencing the problem and investigating it from all perspectives.

The second stage of SSM is to express the problem situation. This was done by having participants construct rich pictures in the first SSM workshop. This allows for the illustration of complex interactions between multiple actors (Checkland & Poulter, 2006). Concerns and interests are depicted using think bubbles, and crossed swords represent conflict between actors. Rich pictures enable the identification of issues (Brenton, 2007).

The researcher encouraged participants to use as few words as possible, and rather to use cartoons or stickmen in the construction of the rich picture. Participants were placed in two groups, provided with a flip chart and markers, and asked to visually represent who they thought the different stakeholders were, what their issues were, and to provide linkages between the stakeholders.

Participants evaluated the rich picture exercise at the end of the workshop. The exercise was described as challenging, interesting, and thought provoking, and a new experience, which was considered frustrating by participants at first. Whilst the major stakeholder groups were present in the workshop, only eight participants were able to attend the workshop. Stakeholders indicated

The problem situation is depicted in the rich picture in Figure 1. The weather is considered critical to the survival of all. The mill is central and places emphasis on reliable cane supply, quality cane, and mill efficiency. The headquarters oversees operations at the mill, and is concerned about profitability and its shareholders. The mill receives cane from three distinct categories of growers: (a) large-scale, (b) emergent, and (c) small-scale. Hildebrand (2002) found that the miller and growers are reliant on each other to ensure that they both gain competitively.

As indicated in Figure 1, the various growers had different goals and concerns. Large-scale growers were mainly concerned about transport, efficiency, viability, profitability, and achieving maximum yield. Emergent growers largely experienced difficulty in ensuring sustainability due to lack of experience. Small-scale growers were primarily affected by economies of scale, and grappled with high contracting charges and lack of finances. The rich picture is a valuable tool for researchers to gain insight into competing goals, values, and perspectives of stakeholders in a given context, which might not be easily extracted from standard qualitative research methods.

Hauliers transport the cane from the farms to the mill and are mainly concerned with profitability through efficient utilization of their equipment. The Sugar Research Unit plays a role through the work of extension officers who ensure best practice and research into ways to obtain quality cane. There are competing mills in the broader area that pose a threat to the mill. Farmers could also choose to send their cane to competing areas that are located within a reasonable distance, and which would not dramatically increase transport costs. Government departments play a role through regulations which have an impact on the transport of cane, how agricultural practices and labour can be conducted, how issues around the environment and water in relation to farming occurs, and how the sale of sugar is managed. The National Sugar Association is key at a higher level because it is involved in the sale of sugar, regulation of the sugar industry, and the export of sugar.

The crossed swords in the rich picture indicate tension or conflict between stakeholders. Tension exists mainly between the large-scale growers and the mill. There is an atmosphere of mistrust, which respondents described as resulting from various factors or perceptions that exist. Stakeholders were found to be operating in silos and mainly concerned about their own well-being. Tension also arises due to a perception that the executive leadership of the mill (headquarters or HQ) is only concerned with the well-being of shareholders, and that there is a lack of transparency about what occurs at the mill. Hildebrand (2002) points to the reality of the obligation to shareholders in private mills, who choose to stay on as investors only if they are able to realize economic returns. There is also a feeling that growers are price-takers who cannot influence the mill, and are hence at the mercy of the miller. It is critical for stakeholders to display commitment to the survival of the mill area, to focus on enhanced performance against competitors, and to avoid internal conflict (Hildebrand, 2002). The division of proceeds also appears to fuel the conflict between growers and the miller because it appears that growers are of opinion that they do not receive enough of the proceeds. This matter is, however, perceived as originating at the industry level, but it affects the local level as well.

The rich picture also illustrates conflict between hauliers and the large-scale growers, and hauliers and the mill. Poor performance from the hauliers negatively impacts on the miller and growers because it results in the deterioration of cane, which affects both parties. Effective communication between the various stakeholders was considered critical due to the high levels of interdependency.

This SSM investigation was not commissioned by a client as such, but formed part of a larger research project to explore the hard and soft aspects of the sugar industry. The client, as in the research of Al-Zhrani (2010), can be conceived of as partial clients who do not present as a single entity or company. The partial clients, as perceived by the researcher, are the growers, miller, and

HQ. The researcher assumed the role of practitioner in applying SSM to address the issues in the mill area. The issue or problem owners, as classified by the practitioner, are the growers, miller, HQ, hauliers, Sugar Research Unit, National Sugar Association, and Government. While the Government was not involved in this research, it would be useful to draw them in to become involved in addressing the issues facing the sugar industry.

Engaging in the rich picture transformed an unstructured problem situation into an expressed situation, and enabled the selection of relevant systems from the problem themes (Checkland, 1985). Checkland (1985) advises that the most critical issues be selected. Eight relevant systems relating to the issues identified through data analysis were selected and are listed below:

- Appreciation of the different stakeholders
- Improving the sustainability of small-scale growers
- Improving mill efficiency
- The consistent delivery of quality cane
- Improving communication
- Increasing cane supply
- Better division of proceeds
- Improving working relationships

Root definitions, CATWOEs, and conceptual models were consequently developed for each of the eight systems indicated above. The second SSM workshop was aimed at presenting the eight SSM models to the stakeholders and having them interrogate and take forward what they considered valuable. Participants were presented with the eight models and asked to vote for the issues that deserved attention. Participants then voted on what systems they considered to be most critical. Stakeholder appreciation, sustainability of small-scale growers, the consistent delivery of quality cane, cane supply, and division of proceeds were identified as critical issues. The outcome, based on tallying participants' choices, was to focus on a system for the consistent delivery of quality cane. The next section will outline the root definition, CATWOE, and conceptual model for a system for the consistent delivery of quality cane. The other systems are not presented in this paper.

Root Definition and Conceptual Model

Figure 2 and Figure 3, respectively, present the root definition and conceptual model corresponding to a system for the consistent delivery of quality cane.

A grower- and haulier-owned system, operated by hauliers, growers, and the mill, to enable consistent delivery of quality cane according to the defined rateable daily deliverables, by following good agricultural practices and ensuring efficient transport to the mill to enable the consistent delivery of quality cane, within the constraints of the availability of input resources and weather.

Figure 2. Root definition for the consistent delivery of quality cane.

C	Mill, growers
A	Hauliers, growers, mill
T	Enable consistent delivery of quality cane according to the defined rateable daily deliverables
W	Follow good agricultural practices and ensure efficient transport to the mill to enable the consistent delivery of quality cane
O	Growers, hauliers
E	Available input resources, weather

Figure 3. CATWOE (Customers, Actors, Transformation, Worldview, Owners, and Environment).

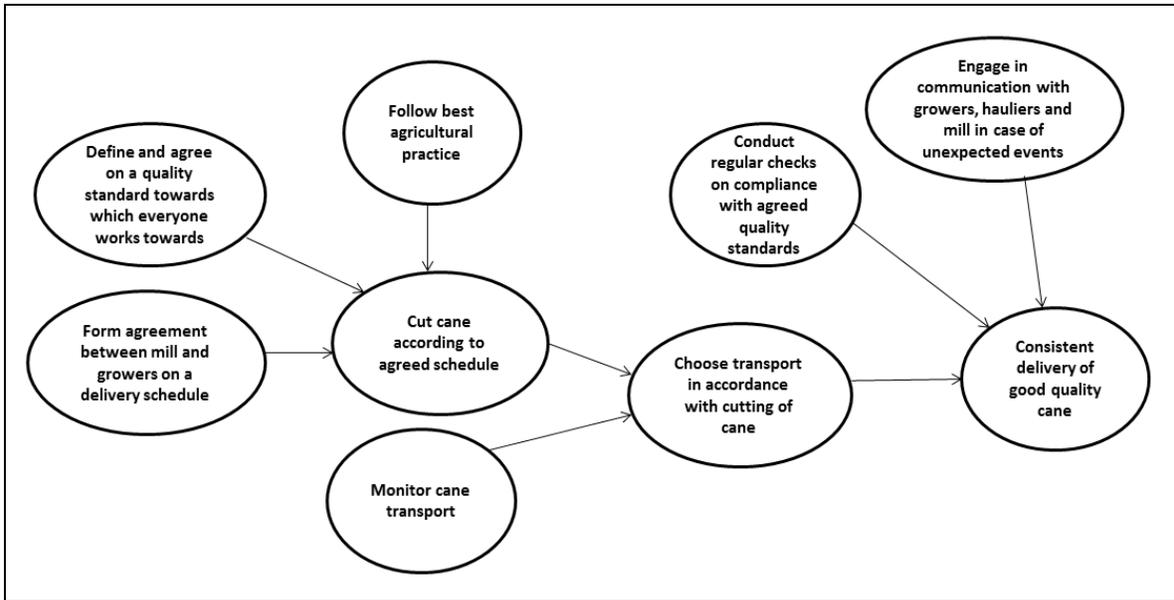


Figure 4. Conceptual model for a system for the consistent delivery of quality cane.

The conceptual model is presented in Figure 4. It is important to bear in mind that there is no right or wrong way of describing activity in conceptual models, and that it is about presenting descriptions derived from multiple, valid interpretations of viewing the world (Khisty, 1995).

Debate and Action

SSM workshop 2 took on a dialogical mode because participants presented their opinions on how to proceed in relation to the conceptual model (Figure 4) that was presented. Participants were encouraged to compare the model in relation to what occurs in the real world. A similar approach to Kayaga's (2008) study in using SSM in the water sector in Uganda was used, whereby stakeholders were encouraged to identify reasons for why the real world situation differed from the ideal model and how the situation could be improved. The conceptual model was therefore critical in initiating debate among the stakeholders.

The systems or models are merely devices to stimulate debate among stakeholders and should not be imposed on the situation (Luckett & Grossenbacher, 2003). The debate does not lead to an improvement of the models but to an accommodation of the perspectives and interests between the stakeholders (Luckett & Grossenbacher, 2003). In interrogating the conceptual model, participants observed that the National Sugar Unit would also have to play a critical role in ensuring quality cane through close working relationships and awareness of best practice with regard to cutting of the cane. The role of an efficient haulier was critical in ensuring quality cane. Participants also highlighted the role of effective communication between the stakeholders to ensure quality cane.

Participants suggested that a vehicle scheduling system be designed, which could involve the mill taking responsibility for haulage, or joint ownership by the miller and the growers. There was, however, concurrence that such action would require coordination between the stakeholders. Participants noted that there were currently approximately 17 hauliers in the mill area, and that ideally there should only be three or four. Such coordination, however, required a willingness to participate from all stakeholders, which was challenging considering that some were in a comfort zone.

Participants pointed to the need for all players to do what they do best (growers to grow cane, the miller to crush cane, and hauliers to deliver cane). It was also highlighted that there were currently three profit centres fighting against each other and that total buy-in and trust were pivotal. It was important to look past resource constraints in order for both parties to benefit. Participants also noted that as much as there was agreement between stakeholders at the workshop about taking action, the involvement of headquarters was critical, as well as commitment from the many growers in the mill area who would need to be approached by the grower leadership.

Evaluations of the workshop indicated that participants valued the opportunity to engage in discussions affecting the system. The workshop was described as practical and comfortable for participants to put forward their opinions. Awareness was raised that stakeholders had to jointly discuss common issues which no one party was able to resolve by themselves. It was also beneficial for stakeholders to see how the issues were overlapping. Stakeholders, however, noted that the attendance of key decision makers, such as the mill executive (HQ) and grower leadership, at the workshop would have made a huge difference. An interesting observation made by participants was that the sugar industry was complex and that it was difficult to implement change.

Based on the rich discussions that were held, possible actions that stakeholders could take to bring about improvement were identified. These actions included introducing one major haulier, investing in replanting and seedcane, improving cane quality, and mentoring for small-scale and emergent growers.

Discussion

The first SSM engagement with stakeholders identified a variety of issues affecting the sugar industry, as reflected in Figure 1. A benefit of SSM is that structural and social factors, which have compounded the problem, can be identified (Reid, Gray, Kelly, & Kemp, 1999). Through the SSM cycle, not only were stakeholders in the sugar industry able to view these issues, but also they were provided with the opportunity to jointly decide which issues to address to bring about improvement. Evaluations from the workshops indicated that stakeholders appreciated the opportunity to jointly discuss common problems plaguing the system. Reid, Gray, Kelly, and Kemp (1999) found that the SSM process organized a poorly-defined situation, which was perceived differently by various stakeholders. As Lockett and Grossenbacher (2003) also found in their research, SSM assisted in thinking about the multiple perspectives in the problem situation and surfacing political issues, as indicated in the rich picture in Figure 1.

This research, which employed traditional qualitative methods and SSM, brought together diverse stakeholders in the sugar industry who possessed different views on the problem, and who ordinarily may have dealt with the over-lapping issues individually. Problem structuring is significant in SSM and assists stakeholders in challenging their worldviews (Winter, 2006). Stakeholders were able to jointly discuss the problem situation and various related aspects. It was evident that stakeholders had engaged in learning, which according to Khisty (1995) is a central part of the SSM process required for participants to take action to bring about improvement to a problematical situation. As Lockett and Grossenbacher (2003) assert, learning occurs through debate about the differences between the conceptual models and reality. This was particularly important because stakeholders were able to jointly discuss issues, and most importantly to understand the worldview of other stakeholders. Cordoba and Farquharson (2008) argue that participants also engage in learning as their views on reality change.

Taylor, Baskett, Hughes, and Wade (2007), in their application of SSM, found that one restriction was that the audience might not have been aware of the methodology or willing to collaborate with other stakeholders. Participants in this research initially experienced resistance with the rich

picture exercise, and may not have realized, as Checkland (1985) described, the value of expressing the situation on paper as they lived through it day by day. Participants also indicated in the evaluations that they may not have been entirely honest about the issues that exist due to the presence of other stakeholders. It is thus critical to realize that stakeholders need to keep up appearances, which are necessary for ordinary real-world interactions. The limitation of SSM in not being able to bring about action in such a situation with the described stakeholder dynamics can be better comprehended using Jackson's (as cited in Warren, 2002) System of Systems Methodology (SOSM) grid. The sugar industry can be classified as complex, displaying both pluralist and coercive aspects. A pluralist situation is characterized by participants in a problem situation who are able to reach consensus or compromise, despite differences in interests and objectives (Mingers & Brocklesby, 1997). A coercive situation, however, is defined by inherent conflict, thereby preventing compromise, and resulting in the use of power to reach an outcome (Mingers & Brocklesby, 1997).

A limitation in this research was that senior decision makers, particularly from the mill, could not be present, thus preventing a firm commitment to taking further action. Checkland and Poulter (2006) outline the reality of not always being able to include senior people in SSM investigations because of their demanding schedules. In addition, stakeholders could not openly discuss issues because of power roles. Checkland and Poulter (2006) found that people are generally reluctant to discuss the culture and politics of a situation because they feel they are familiar with it, but that this is merely a manifestation of their "this is the way we do things around here" attitude. Cordoba and Farquharson (2008) also found in their SSM engagement that younger and less experienced participants were not willing or able to participate in in-depth discussions, thus leading the researchers to deduce that the presence of hierarchy and expertise limited effective interaction. Luckett and Grossenbacher (2003) argued that the political and cultural aspects of the study might be influenced by who the researcher chooses to involve in the investigation. This research study was, however, open for all stakeholders in the mill area to attend.

As suggested and defined by Checkland and Poulter (2006), the researcher can also use SSM to examine the roles, norms, and values, and the inherent political nature of any human social system. Roles refer to the differences in social position among people in a group, which can be formal, through titles held, or informal. Norms represent the expected behaviours that correspond with a role, whereas values signify the standards people use to judge behaviour. Checkland and Poulter (2006) recommend that the practitioner reflect on these three elements in a situation. With reference to the problematical situation, we gradually became aware of marked differences in roles, norms, and values between the miller and growers, which are discussed below.

Growers are individuals tasked with the sole responsibility of attaining success, and who are expected to excel in a variety of areas such as farming, managing labour, utilizing business skills, planning, strategizing, and engaging in effective decision making. Growers may use their limited capital outlay to only invest in sugar cane farming, and will thus be reliant on the miller. They have fairly simple operations and business structures in place, which do not necessarily have to be concealed from other growers to attain a competitive edge. They may not only strive for profits but if losses are incurred, the grower as an individual suffers.

The miller is a corporation with a formalized, hierarchical structure and a clear line of authority, with people at different levels who are tasked to perform certain functions. The miller naturally has a business edge through ready access to diverse skills and resources. With a large capital outlay, the miller has a responsibility first and foremost to shareholders. The organizational culture impacts the extent to which the miller is able to share information and strategy with stakeholders.

Based on the above analysis of the roles and norms, growers' values may center on transparency, rapid decision making, ground level interaction, and not only on profit making. The miller on the other hand, may expect growers to be united and to display business skills, and an appreciation for attaining profits. This analysis is critical as the differences in roles, norms, and behavior between stakeholders could limit the effectiveness of the debate and action stage in the SSM process.

Another useful analysis in the investigation was that of considering how power is expressed in the situation (Checkland & Poulter, 2006). Issues relating to the attainment of power, how it is manifested, and its evolution can be examined (Khisty, 1995). This will be in the form of identifying commodities, which will indicate where power is located in the situation (Checkland & Poulter, 2006). It appeared that the miller had the dominant power by possessing the commodities of financial, human, and intellectual resources. It was also clear that large-scale growers held more power than small-scale and emergent growers due to being well established and familiar with the industry. Cordoba and Farquharson (2008) thus recommend that ways be found to improve the ability of SSM to assist participants to deal with issues around power and how they work within the status quo, and not just to reflect on norms, roles, or values of the problem situation.

This study has illustrated the methodological value of SSM. It was found that the methodology not only allows researchers to identify issues, but also allows stakeholders to present their perspectives on the multiple and overlapping issues that they face. This research has clearly illustrated the reality of multiple, valid perspectives that various individuals hold. The study highlighted how the methodology facilitates a systemic perspective by avoiding a situation where the researcher only focuses on one stakeholder group or on a narrow range of issues. The investigation further emphasized how researchers can gain valuable insight into a study context by engaging in analysis of the roles, norms, values, power, culture, and politics of the problem situation. It was also observed that SSM enables participants, through collective engagement, to identify actions to bring about improvement to these issues. Such engagement also facilitates collective learning among participants because they gain a systemic perspective from rich conversations. These conversations also illustrated how social reality is constructed and reconstructed. The debate that emerges challenges participants' worldviews and provides insight into how to deal with the problems, which ones to address, and how all stakeholders can contribute to bringing about improvement. This methodology highlighted how to engage participants to hear their perspective; this is in line with the principles of qualitative research, where the researcher is not far removed from respondents, and does not come across as the expert.

The study emphasized the value of the diverse SSM tools (rich picture, root definitions, CATWOE, and conceptual models) with which to engage respondents and facilitate debate. The rich picture, in particular, affords the researcher the opportunity to explore the subjective interpretations of participants by analyzing stakeholder goals, values, and perspectives. These SSM tools increase the validity of the research, and provide participants an opportunity to examine the accuracy of the findings, and in so doing, give further meaning to the collaborative aspect of this type of research.

It is also useful to reflect on the limitations of this methodology. As much as SSM provides an opportunity for identifying actions that stakeholders can take to bring about improvement, problems may arise in getting participants to take ownership. Stakeholder participation in the SSM process is therefore critical in influencing the extent to which stakeholders are able to bring about change. There is no guarantee that the methodology will facilitate open and honest dialogue; in fact, a certain maturity and willingness is required from participants. Dynamics and structures in the real world, such as organizational policies, procedures, and culture, as well as

power dynamics, can also affect the SSM process. An enabling environment, along with support and participation from senior decision makers is pertinent to the success of the methodology. Although the methodology provides tools and clearly sets out the stages of the SSM process, there is a lack of guidance for the researcher, who is the key instrument in qualitative research, on how to facilitate beyond the mere identification of issues, and on how to work through the issues to eventually enable action.

Conclusion

The aim of this exploratory research was to explain, illustrate, and critique SSM by reflecting on its application in the sugar industry. This research used traditional qualitative research and SSM to organize and structure thinking about a messy situation where multiple human interactions created complexity. Issues of a traditionally technical nature, such as cane quality, cane supply, and transport, were identified, as well as issues that were related to stakeholders' perceptions of their reality. SSM tools were developed to allow stakeholders to view the situation, and jointly debate how to bring about improvement. Discussions from the workshops resulted in the compilation of a list of possible actions needed to bring about improvement. Due consideration was given to who should be involved, what the limitations were, and what actions should be taken. Roles, norms, values, and power relations in stakeholder interactions in the sugar industry were described. The research revealed the importance of the involvement of all relevant parties, especially those with power and decision-making abilities, to bring about action through the SSM process.

This study, which was the first to apply SSM in the sugar industry, was significant in indicating the value of this methodology. The research illustrated the importance of not only focusing on traditional "hard" aspects alone to solve industry problems, but also the "softer" aspects underpinned by human perceptions and accompanying worldviews. From a methodological perspective, this investigation was particularly valuable in being able to both identify and address issues affecting various stakeholders, who ordinarily may not have had the opportunity to jointly engage in shared concerns about the sugar industry. Furthermore, this study employed a holistic perspective, analyzed the problematical situation, and avoided only focusing on one area of concern or one particular stakeholder group. This research also facilitated the awareness of the interdependence among stakeholders in the sugar industry, and the need to find a common identity, despite the pursuit of individual goals and objectives. Given the complexity of the problematical situation and the overlapping nature of the multi-faceted problems, no-one stakeholder group is in a position to address these problems alone. Stakeholders were able to explore reasons for differences between the real world and the ideal scenario as presented in the models. This methodology enabled a collaborative relationship between researcher and respondents, and provided tools for the researcher to gain insight into the multiple perspectives, values, roles, and norms that were held by different individuals in the study context. It was found that facilitation skills were critical in navigating the methodology. Limitations of the methodology include the following challenges: (a) getting participants to take ownership, (b) getting participants to engage in honest dialogue by displaying willingness and maturity to address the issues, and (c) getting participants to move past real-world organizational dynamics.

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