



Dr. Jörg Meyer-Stamer Scholarship

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# Experiences with seeking intervention in a complex system

Application of the viable system model (VSM) in a complex sugarcane production and supply system

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**DR. JÖRG MEYER-STAMER-SCHOLARSHIP RESEARCH PAPER SERIES**

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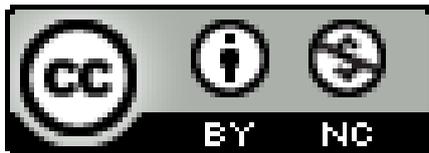
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## Chapter 1 Introduction

This paper presents the outcomes of a project that was conducted in one of the 14 sugarcane milling areas in South Africa. The project intended to take parts of the findings which resulted from my PhD research<sup>1</sup> forward by facilitating change that leads to improvements; however, this aim could not be realised. As a result, this paper focuses on the experiences that were gained from seeking to intervene in a complex system, and some relevant lessons that might help others to deal with complex systems are shared.

The paper comprises three main sections and ends with a brief conclusion. The first section outlines the background to this project, the Viable System Model (VSM) and the findings that emerged from the VSM diagnosis which formed the basis for this project, and the original assumptions. The project progression is described next, followed by a discussion of the key findings and the lessons that can be learned from an apparently unsuccessful project.

The term “system” generally refers to the sugarcane milling area that was investigated, which is an integrated sugarcane production and processing system. It consists of sugarcane growers, hauliers and millers, and comprises the production, harvesting, transport and processing of sugarcane.

### 1.1 Background to the project

The South African sugar industry is already relatively efficient, but several possibilities for performance improvement exist (Bezuidenhout and Baier, 2011; Le Gal et al., 2008; Giles et al., 2006). Much inefficiency is attributed to the complexity of sugarcane production and supply systems. This complexity arises from environmental factors, but especially from the presence of multiple interacting agents who are interdependent, yet often have different views and expectations and partly competing objectives (Bezuidenhout et al., 2012; Perry and Wynne, 2004; Higgins et al., 2007). The degree and the effects of the complexity need to be better understood, which requires a holistic approach that considers the complex and multidisciplinary nature of sugarcane supply chains (Higgins et al., 2007). For this reason a multidisciplinary research project<sup>2</sup> comprising a close collaboration between academics from the Graduate School of Business and Leadership (University of KwaZulu-Natal), the School of Engineering (University of KwaZulu-Natal) and specialists from the sugar industry was initiated. The project ran over the last three years (2010 – 2012) and my PhD research was embedded in this larger project.

In contrast to other research in the sugar industry, I used a systemic approach to explore the complexity of two milling areas, whereby soft issues, such as trust, communication and relationships received special attention (Hildbrand, 2013). These issues are often the underlying causes of inefficiencies, yet they appear to be neglected (Gerwel et al., 2011; Higgins et al., 2007). In one of the milling areas studied, I combined qualitative research methods with the Viable System Model (VSM). The VSM diagnosis led to a better understanding of the complexity of this milling area. It

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<sup>1</sup> Hildbrand, S (2013). Systemic approaches to improvement in sugarcane production and supply: Umfolozi and Felixton mill areas. PhD Thesis, Graduate School of Business and Leadership, University of KwaZulu-Natal, South Africa. 266 pp

<sup>2</sup> Project title: Refinement and Implementation of Improvement Processes to the Integrated Sugarcane Supply and Processing System

revealed several inefficiencies whose handling would support systemic competitiveness of the milling area and increase the revenue of its many stakeholders. The VSM diagnosis further facilitated the determination of some improvement recommendations. However, change facilitation is needed to deal with present shortcomings and to implement improvements.

In the PhD research there was neither a real possibility to discuss the outcome of the VSM diagnosis with relevant stakeholders nor to probe the resulting recommendations. It thus seemed important and highly beneficial to expand the PhD research to explore opportunities to increase the efficiency of the investigated milling area through knowledge transfer and change facilitation. Consequently the main aim of this project was change facilitation and knowledge transfer regarding the complexity of sugarcane production and supply systems in order to add value to the sugar industry and the milling area studied. I intended to elaborate on and present and discuss the outcomes of the VSM diagnosis with crucial stakeholders to take the findings of the VSM diagnosis forward and develop and implement improvements. Stakeholder engagement and change facilitation techniques were meant to support in particular the development and implementation of recommendations that assist in the handling of underlying soft issues. I further sought to introduce VSM to industry stakeholders and explore the extent to which a VSM diagnosis supports the understanding and handling of complex systems. This led to the following research questions:

- How can a VSM diagnosis assist in the understanding and handling of complex sugarcane production and supply systems?
- How can the shortcomings that emerged during the VSM diagnosis be addressed?
- What approaches to facilitate change are likely to promote implementation of recommendations from a VSM analysis by stakeholders?

VSM has thus far not been applied in the sugar industry, but has shown its outstanding diagnostic competency and its ability to assist in the management of complexity under similar circumstances. The PhD research confirmed the diagnostic capacities of VSM on a theoretical level, hence there seemed to be merit in exploring the practical benefit of the VSM diagnosis. In addition, the outcomes of this project not only seemed to be transferable to other sugarcane milling areas, which presumably face similar challenges, but also to other multiple stakeholder settings confronted by comparable complexity.

This project was far from being a rapid diagnose-and-fix-it approach, since it was based on an in-depth investigation of the milling area studied as part of my PhD research and the experience I have gained from working with the sugar industry for over three years.

## **1.2 Basis of the project**

### **1.2.1 The Viable System Model (VSM)**

The Viable System Model (VSM) was established by Stafford Beer (Hoverstadt, 2010; Beer, 1985). A viable system is characterised by an independent existence, has an identity, is self-sustaining despite disturbance and is capable of adapting. VSM is a generic model and can thus be applied to an individual, an organisation or a company. Furthermore, it is very useful in a non-organisational context and it works well in a multi-stakeholder setting. For example, Stafford Beer applied VSM in

Chile (Medina, 2006), and my VSM application to a sugarcane production and supply system clearly demonstrates its diagnostic value in the non-organisational context (Hildbrand, 2013). However, in this context, particular focus needs to be placed on the normative management system (explained below), as it is responsible for achieving cohesion among the different sub-units.

VSM has been receiving increasing appreciation by managers, researchers, system analysts and consultants (Schwaninger, 2006). They have successfully applied VSM to diagnose weaknesses in existing systems, to design new viable systems and to handle the increasing degree of complexity confronting any manager (Hoverstadt and Bowling, 2002; Johnson and Liber, 2008; Espinosa and Walker, 2006; Leonard, 2006). Furthermore, the thoroughness of a VSM diagnosis, which considers the dynamic relationships within a system and between the system and its environment and leads to a comprehensive understanding of the system, is outstanding. Jackson (1988) argues that VSM outperforms many other management models.

Given these competencies, VSM was used for the PhD research. The competencies of VSM are based on its grounding in systems thinking and cybernetics. VSM incorporates theoretical concepts, such as black box technique, self-regulation via feedback loops, variety engineering via Ashby's Law of Requisite Variety and recursion. An overview of VSM is given in Figure 1.

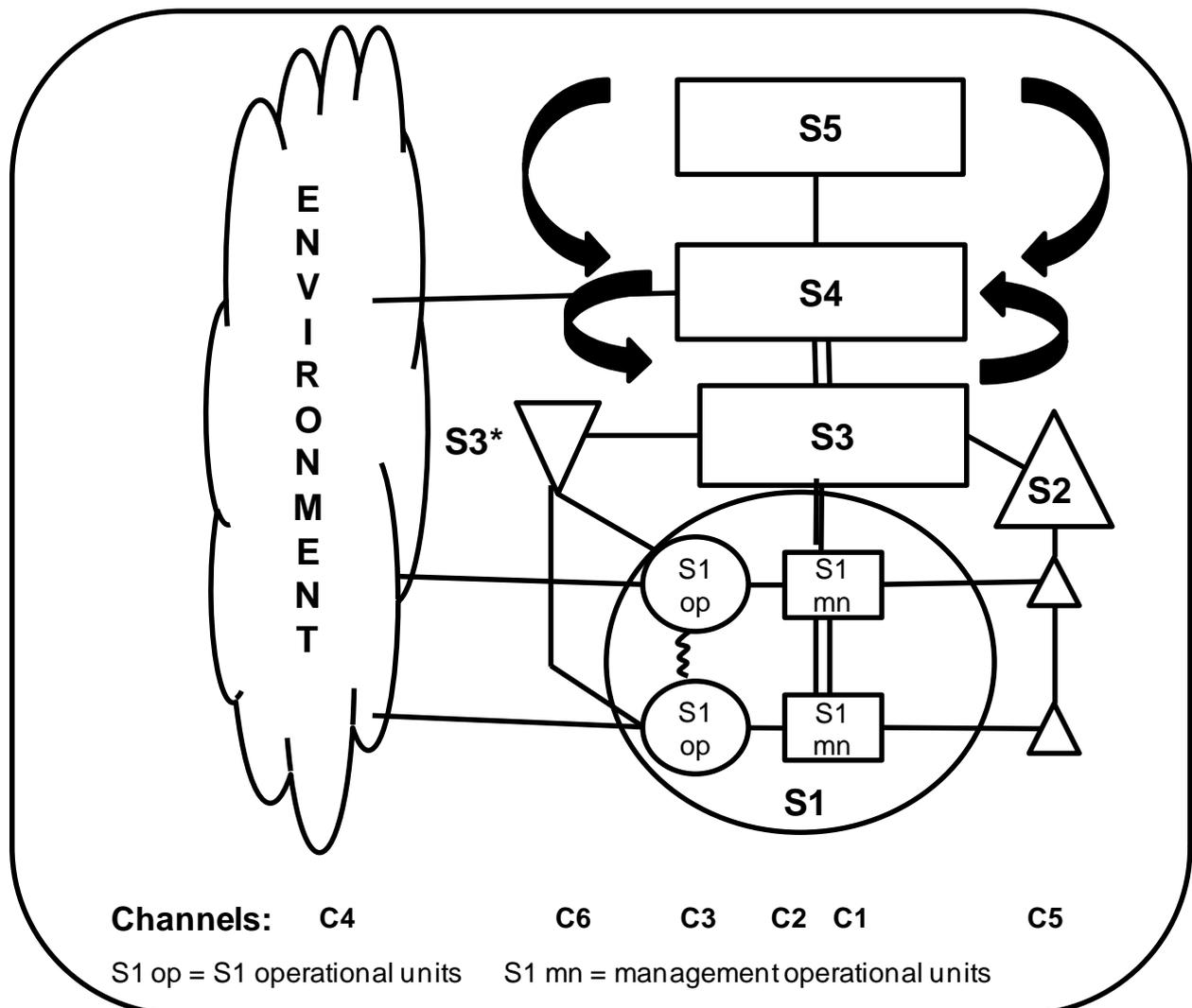


Figure 1: Overview of VSM (Adapted from Hoverstadt (2010) and Beer (1985))

As shown in Figure 1, VSM consists of five subsystems (S1–S5) and six channels. The existence and proper functioning of these subsystems and channels is essential for a system to be viable. The channels serve as communication channels and feedback loops (Jackson, 1988). The five subsystems (S1–S5) can be briefly summarised as follows (Jackson, 2000):

- S1: The operational units and their direct management, which perform the organisation’s actual task and interact directly with their associated environment.
- S2: The coordination system, which is responsible for coordinating the operational units, ensuring smooth running and preventing oscillation.
- S3 and S3\*: The daily management and control system, which deals with any managerial issues, conducts resource bargaining with the operational units, oversees resource use, has implementation power and monitors the operational units. It is obliged to perform its function in a facilitatory rather than an autocratic manner.
- S4: Looks at the outside and the future. It considers any external events and potential future developments that impact on the system and ensures appropriate adaptation towards them.
- S5: The normative management system where all the threads come together. It defines the identity, vision, culture and direction of the system and thereby ensures the cohesions of the whole.

### 1.2.2 Outcome of the VSM diagnosis

A VSM diagnosis assesses the viability of a system. It evaluates the presence and proper functioning of the five subsystems and six channels and the system’s compliance with the underlying principles of VSM (Beer, 1985). This requires the definition of the system-in-focus, its next lower and next higher level of recursion, and the creation of a VSM of the studied system (Gregory, 2007). The generated VSM is compared with the generic VSM to reveal the actual functionality of present operations (Espejo, 1989, Beer, 1981). It discloses shortcomings in subsystems or channels of the system (Espejo, 1989).

The VSM diagnosis of the investigated milling area resulted in the following key recommendations (Hildbrand, 2013):

- The miller-grower fragmentation in the system needs attention. Team spirit and a culture of belonging together should be established.
- The leadership in the milling area should champion a more holistic view and highlight the necessity to become system partners.
- The autonomy of the local mill management should be increased and local mill management needs to use the autonomy it has. This implies that local mill management should become more proactive and approachable; it should appreciate growers’ inputs and address their concerns. In addition, the perception of a “powerless and unapproachable” mill has to be

addressed by providing information about the interaction between the grower leadership and the mill management and about the support the mill management has already provided.

- The communication and the provision of information in the system has to be improved. The need for more two-way communication from the growers' side was especially highlighted.
- The miller-grower interaction, especially regarding resource-bargaining and bulk buying, should be increased.
- The consistency in the system needs to be increased by improving the coordination of the miller, grower and haulier interplay. Stakeholders should comply with the DRD-system<sup>3</sup>. In addition, the capacity of the milling area to compensate supply outages from one area by obtaining additional supply from another area should be increased. Likewise, stakeholders should continue with the transport project<sup>4</sup> and consider the implementation of a scheduling system.
- The capacity and power of those mechanisms managing the milling area as a whole have to be strengthened to promote, for example, compliance with the DRD system and the delivery of clean, high-quality sugarcane.
- Hauliers need to be better integrated in the management of the milling area.
- The milling area and the local Canegrowers Association need to be prepared for the expected development towards vertical slicing.
- A joint strategic forum, comprised of miller, grower and haulier representatives, to explore and discuss future possibilities and external risks should be established.

These improvement recommendations resulted from the VSM diagnosis that was conducted during the PhD research. They formed the starting point for this project. In the following sections the assumptions that underpinned this project and consequently impacted on its progression are outlined.

### 1.3 Initial assumptions and hypothesis

At the outset of this project, I assumed that presenting the outcomes of the VSM diagnosis to crucial<sup>5</sup> stakeholders would lead to fruitful discussions resulting in the specification and implementation of concrete improvement opportunities, and I also assumed that I could facilitate this process. I anticipated that once the stakeholders had approved the relevance of the VSM diagnosis and were interested in this project, it would be viable to proceed and be possible to influence the system for the better. I further expected that I would either work with this group of crucial stakeholders or with a task group to address those results of the VSM diagnosis that were

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<sup>3</sup> The DRD (daily rateable delivery) system defines the amount of sugarcane each grower is supposed to deliver per day. The DRD depends on a grower's estimates of the total amount of sugarcane that shall be supplied and the length of the milling season.

<sup>4</sup> A project that explored the possibilities of improving the transport system in the investigated milling area to save costs and increase efficiency.

<sup>5</sup> Stakeholders with influence and decision-making power.

perceived as most important and that were manageable within the scope of this project. This shows that my intention to facilitate knowledge transfer and improvement in the milling area was based on a set of hypotheses. Starting with a set of hypotheses is essential as it reveals the assumptions that underpin a project. As suggested by Cunningham and Jenal (2013), these hypotheses were verified throughout the project and the emerging findings led to a new set of hypotheses.

The project was essentially based on the following hypotheses or assumptions:

1. A comprehensive understanding of a system will facilitate change.
2. If stakeholders perceive an issue as problematic, they will be motivated to address the issue. In other words, if the need for change is seen, change will happen. I thus expected that once the stakeholders had approved the relevance of the outcomes of the VSM diagnosis, they would support this study and work with me towards addressing the issues that they perceived as critical.
3. If stakeholders know about inefficiencies in the system, can quantify them and perceive them as relevant, they will be incentivised to solve the inefficiency and to collaborate.
4. If I offer myself as a resource to the system to assist with the handling of any issue without requesting any reimbursement, the offer will be taken up.
5. All actors that matter are visible to me and I involve them in the study.
6. There are better ways of handling present issues and this will facilitate change.

In the following section the progress of the project is described. This already indicates the need to revise some of the outlined hypotheses. They will be further discussed in Section 3.3.

## Chapter 2 Project progression

The activities and attempts that were made to achieve change facilitation and knowledge transfer are presented in this section. However, as previously pointed out, no tangible improvements could be made. The project had to be terminated owing to the lack of opportunity to act as a change facilitator. There were insufficient stakeholders who had the time, interest and capacity to engage with me in a process of change implementation. By default, the project progression deviated from the original research plan.

A qualitative approach was used to facilitate stakeholder involvement and to gain their views, perceptions, expectations and buy-in regarding the implementation of change. The stakeholders were discerned as pivotal for change. I perceived my role as a facilitator who supported the stakeholders in developing and realising improvement recommendations, and not as an expert who had the answers to the different challenges. The stakeholder engagement consisted of several focus group meetings and telephone and personal interviews. Key stakeholders in the milling area were approached, *viz.* the grower and mill leadership, the extension officer and the grower liaison officer. This stakeholder group was seen as crucial for change initiation as they had at least some decision-making power and influence. An overview of the core activities of this project is shown in Table 1. The area shaded in grey was part of the PhD research, which formed the basis of this project. The project progression was evolving, as the outcomes of each interaction with the stakeholders determined the next stage in the project.

Date	Activity
July 2010 – March 2011 July 2010 – April 2012	<ul style="list-style-type: none"> <li>• Three intensive fieldwork phases comprising in-depth interviews with individual stakeholders and workshops as part of the data collection for the PhD research (Hildbrand, 2013)</li> <li>• Ongoing data analysis which resulted in the final VSM diagnosis</li> </ul>
May 2013	<ul style="list-style-type: none"> <li>• Meeting with sugar industry representatives from SASRI</li> <li>• Approaching key stakeholders in the local milling area</li> <li>• Meeting with key stakeholders in the milling area to introduce the project and obtain their buy-in</li> </ul>
June 2013	<ul style="list-style-type: none"> <li>• Telephone interviews with eight stakeholders to get their individual insight on communication and information provision</li> <li>• Meeting with task group to explore opportunities to improve communication and information provision</li> <li>• E-mail and telephone conversations to follow up on issues that emerged during the task group meeting</li> <li>• Starting to explore alternative opportunities for change facilitation, as the task group meeting failed to lead to the determination of possibilities to assist with improvements regarding communication and information provision</li> </ul>
August 2013	<ul style="list-style-type: none"> <li>• Telephone conversations and meeting with one stakeholder to explore alternative possibilities to add value to the milling area</li> <li>• Contact with Mesopartner regarding the challenges experienced in trying to fulfil the commitments made in the project proposal</li> <li>• Meeting with sugar industry representative to discuss the brix-pol issue of the milling area studied and to determine whether this is an area where assistance would be possible</li> </ul>
September 2013	<ul style="list-style-type: none"> <li>• Decision to determine the project without achieving the original objectives of the project due to the lack of intervention/facilitation opportunities</li> </ul>

Table 1: Activities and milestones of the project

Initially the fieldwork was meant to largely involve stakeholders in the sugar industry and would thus be predominantly conducted in Mount Edgecombe. I intended to approach industry representatives to (a) discuss the outcome of the VSM diagnosis with them, (b) explore how a VSM diagnosis could assist the sugar industry in understanding and handling its complexity, and (c) investigate how insights gained could be taken forward to promote the sugar industry. However, after an initial meeting with a few industry representatives from the South African Sugar Research Institute and consultation with my supervisors, I shifted my focus and largely engaged with the stakeholders in

the local milling area where the VSM diagnosis was conducted. A first meeting with key stakeholders was set up. The purpose of this meeting was to introduce this project, provide a brief overview of VSM, present and discuss the recommendations that resulted from the VSM diagnosis (see Section 1.2.2), obtain the stakeholders' buy-in of this project and define an issue that will be addressed in the course of this project.

All the stakeholders confirmed the relevance of the findings presented. The topic that the stakeholders perceived as most crucial was the fragmentation between millers and growers and the need to establish team spirit and a culture of belonging together. However, this issue was too deeply embedded in the system to be addressed within the scope of the study. Thus the stakeholders jointly chose another topic to work on, namely communication and information provision. It was believed that the handling of this topic would also add to improvements regarding miller-grower fragmentation. This topic was chosen because it was relevant and seemed appropriate for an intervention project such as this. At the end of the meeting the stakeholders agreed to proceed with a project that aimed at improvements in communication and information provision and designated a task group to work with me. The task group was largely comprised of the key stakeholders who attended the initial meeting.

I was tasked to obtain and consolidate the key stakeholders' views regarding communication and information provision prior to the first task group meeting. I consulted the findings from my PhD research and conducted telephone interviews with several stakeholders. The analysis of this data illustrated the key communication and information provision issues in the mill area. These issues were predominantly related to two core themes, *viz.* operational and communication shortcomings, which refers to the fact that information is sent out by the mill, but there is a lack of feedback from the growers and hauliers, and interpersonal communication shortcomings, which means that communication between miller and grower leadership on pertinent and strategic issues needed to be improved. The outcome of this investigation was presented at the first task group meeting, which had three objectives:

1. Confirm the significance of the issues presented.
2. Facilitate a better understanding of the communication and information provision problem. The problem needed to be defined concretely, specifically and tangibly, and an illustration of its implications needed to be included.
3. Discuss possibilities of dealing with the issue and defining concrete steps that should be taken.

The task group participants approved the significance of the issues presented. The following facilitated discussion provided more insight into the topic, such as quantifiable shortcomings that were caused by communication and information provision shortcomings, and it pointed to some possibilities to address the issue, but no concrete suggestions were made or actions determined on how to proceed with the project and implement improvements to communication and information provision. Ideas were raised, discussed and then discarded as they were apparently not feasible. There seemed to be a lack of resources and commitment to engage any further with the issue of communication and information provision and to make changes. The meeting basically ended with some stakeholders signalling that they appreciated the work that had been accomplished during the PhD research and the effort that had gone into this project, but from then on they would be working

on this issue by themselves. Nevertheless, they highlighted the fact that the engagement with the milling area during the PhD research had led to a better understanding of their system and allowed some improvements to be initiated. They further proposed that should there be an area where I could assist, they would approve my involvement, and suggested that I could, for example, explore possibilities with the grower liaison officer.

Based on the discussions in the focus group meeting, there still seemed to be a huge benefit that would result from improving the feedback growers give to the mill (operational communication shortcomings). The fact that the growers failed to comply with the DRD system and inform the mill that they would not deliver was highlighted as having a tremendous impact on the system with costs for millers and growers. Miller and grower representatives confirmed the relevance of the issue in conversations after the first task group meeting. However, in the end it turned out that this issue seemed to be unproblematic in this year given the greater available sugarcane supply, which ensured that the mill could keep running. Consequently, there was no real scope for change facilitation. Likewise, regarding interpersonal communication, there was no real opportunity to assist in improvements, although this engagement with the milling area clearly re-confirmed that interpersonal communication was a critical issue.

I contacted the mill manager and the grower liaison officer several times to explore whether there were other possibilities of adding value. However, possible paths did not lead to involvement in any initiative or project. After attending a meeting with sugar industry representatives where the “brix<sup>6</sup>-pol<sup>7</sup>” issue was discussed, a topic that causes a lot of frustration in the milling area investigated, it became clear that the opportunity for a involvement had also faded. Given these challenges, the project was terminated without having fulfilled the commitments made in the project proposal. In the following section the key findings and key learnings that can be drawn from this experience are discussed. This includes a reflection on the initial hypotheses and the research questions posed.

## Chapter 3 Discussion of key findings and learnings

### 3.1 Change implementation

This project did not achieve what it set out to achieve. My core aim was to facilitate change, and through change and knowledge transfer, add to the sugarcane production and supply system studied. The stakeholders confirmed the relevance of the issues that I had derived from the VSM diagnosis and presented to them. The millers and growers identified miller-grower fragmentation as the core challenge, but mutually agreed that its handling was outside the scope of this project and that the focus should be placed on improving communication and information provision. This project thus had buy-in from the area leadership. However, no change implementation was achieved despite the stakeholders having agreed with the relevance of the issues brought to light, signalled their desire to proceed and acknowledged the importance of dealing with these issues and discussing possibilities to address them.

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<sup>6</sup> Brix: all solids dissolved in sugar juice, liquor or syrup

<sup>7</sup> Pol: sucrose content; Brix-Pol: non-sucrose content, “waste” that cannot be used for sugar production. Based on industry regulations it should be under 2%, but in the investigated milling area it is always higher, which causes miller-grower tension

The stakeholders repeatedly stated that the present inefficiencies caused huge costs to all of them and that they knew about it, yet there was little incentive to address the issues and no concrete suggestions were made or actions proposed. It was impossible to establish a committed task group to proceed with the project and to address, for example, communication and information provision shortcomings. My offer to work with the stakeholders on any issue that they perceived as relevant was not taken up. No one asked for my assistance with any other issue, despite my seeking opportunities to add some value. Essentially there was no project where my input was desired or requested. The stakeholders were either not interested, did not want to or were unable to commit their time and capacity to this kind of change initiative which sought to benefit the entire system. When I attempted to probe deeper to get to the root of the problem and seek viable options for improvement, the stakeholders only opened up to a certain extent. They mostly blamed each other or had the notion that nothing could really be done about any issue and it just needed to be accepted and dealt with the way it was.

This shows that a comprehensive understanding of a system, the finding and confirmation of the need for change, the quantification of inefficiency and the availability of better alternatives do not necessarily lead to change and improvement. A system cannot be forced to change and no one can push a group to address an issue, even if it is described by the stakeholders as a priority.

The following sections discuss why the stakeholders were hesitant to change and why no change happened. They seek to provide a better understanding of change facilitation in complex systems and to assist other change agents by highlighting what needs to be taken into consideration when trying to intervene in these systems. Moreover, some additional findings are presented that are not directly related to change facilitation, but seem to be common phenomena when dealing with human systems.

### **3.2 Potential obstacles for change implementation**

Higgins et al. (2007) and Gerwel et al. (2011) showed that soft issues often hamper change. A systems thinking perspective suggests that even change which is seen as critical can be prevented by such underlying aspects as rituals, habits, norms, routines and traditions. Also, stakeholders might not be able to see a potentially better approach due to personal failures, previous experience, certain worldviews or set expectations. The suggestions for improvement seemed to be too far removed from the stakeholders' view of acceptable or feasible behaviour, which is largely determined by underlying patterns.

These underlying aspects are deeply entrenched in the system and guide its behaviour, even without the stakeholders being aware of their pattern of behaviour. Stakeholders generally do not question these underlying aspects and often cannot remember why they behave in the way they do. Changing the traditions, norms, habits, routines and rituals of the system requires a lot of effort and thus achieving change in traditional systems, such as the sugar industry, is very difficult. For instance, in theory, creating a mechanism that penalises growers and millers for behaviour that has a negative impact on the system, such as delivering poor-quality sugarcane or mill breakdowns, would be a rational recommendation. However, in practice, this would be almost impossible to enforce given the deeper patterns of behaviour. Systems thinking urges the change agent to take these deeply embedded patterns and underlying soft issues into account.

The relevance of soft issues as an underlying cause of inefficiencies and the extreme difficulty of overcoming them was highlighted by this project. The stakeholders named miller-grower fragmentation as a core issue. They acknowledged how deeply embedded it was and the consequent impossibility of addressing this issue within the scope of the project, and instead agreed on addressing the provision of communication and information. As shown, it was not possible to address either operational or interpersonal communication shortcomings. The former might have been less significant than originally suggested by the stakeholders; however its severity was clearly re-confirmed in the course of this project. Interpersonal communication shortcomings and a culture of mutual blame were revealed. In group interactions, this issue was hushed up and it seemed that the relationship and communication between millers and growers had improved, but in my personal conversations with the stakeholders these shortcomings were clearly spelled out. This leads to another point, the difference between what people say in a group and as individuals, which is discussed later.

Uncertainty about whether there may be unintended consequences that affect the stakeholders' profitability or relations can also prevent change implementation. This highlights the need to apply a holistic approach, consistently reflect on all potential impacts of interventions and to verify the suitability of original hypotheses.

Any change comprises gain and pain. One party will benefit more than the other. Current change initiatives focus insufficiently on the party that loses. It is insufficiently compensated. There seems to be a need for an "insurance policy" to compensate the disadvantaged party.

A system only seems to change once there is adequate incentive that enables it to change. Adequate refers to the fact that the incentive, i.e. the return on the effort of changing the system or the benefits of a changed system, has to be greater than the costs of resolving the current inefficiency. This relationship is shown in Figure 2. In addition, the challenges regarding change implementation in this project support the change formula developed by Beckhard and Harris (1987), where change (C) only happens when the product of the dissatisfaction with the current state (A), the desirability of a changed state (B) and the practicality of this change (C) is greater than the costs of change. In short, only if  $A \times B \times C > X$  will change occur. The fact that the product needs to be greater than the costs shows that each of the three factors A, B and C is important (Cameron and Green, 2012). In my project, at least one of them was not big enough, probably C, as otherwise change would have happened.

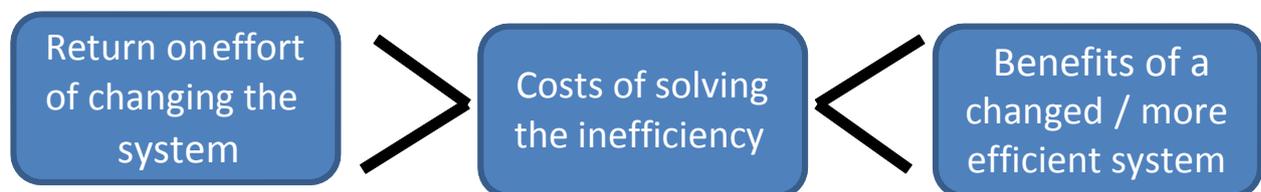


Figure 2: Required conditions for change to happen

The costs of suboptimal communication and information provision in the system investigated was either lower than the expected benefits of improvements in this regard, or the costs of solving this inefficiency were higher than the expected advantages. The latter implies that change is not only dependent on the quantified monetary cost of the inefficiency, but to a large extent on the

underlying patterns that need to be considered and handled, which may not be so easy to quantify. They can add significantly to the cost of solving the inefficiency and they may even have a greater influence than quantifiable efficiency improvements. Consequently the monetary cost of inefficiency is not always the driver of change.

The costs of the inefficiency in the example given may not have been high enough to initiate change for the following reasons:

- In the 2012/2013 season the costs that resulted from the lack of compliance with the DRD system and the subsequent mill closure were approximately 17 million rand. However, in this season, non-compliance with the DRD system had minor impacts on the system, as an increase in the overall cane supply implied that the mill could operate continuously. Therefore, for change to occur, the costs of the inefficiency need to be high throughout. The longer the costs are not painful, the less stakeholders are prepared to change.
- The cost of the inefficiency was not truly felt. The stakeholders did not have to pay more in 2012/2013, but they earned less than they could have. The costs were not real but projected. The stakeholders were still satisfied with the price they were paid and they were not eager to realise a higher price. This suggests that experienced costs are lower if inefficiency affects potential income rather than expenses.
- I assume that many growers lacked awareness about their personal losses that resulted from this situation, and thus the cost of the inefficiency was not fully recognised.

On the other hand, the costs of solving the inefficiency might have been too high to enable change. The following theories and concepts seek to provide an explanation for this and for the difficulties experienced with change implementation in addition to the aforementioned aspects:

- The phenomenon of market failure of public goods (Medema, 2004) applied to the system investigated. All the stakeholders were affected by the poor behaviour of a few of the stakeholders, which decreased their motivation to improve the system as a whole or, in other words, increased the costs of solving the inefficiency. For example, compliance with the DRD system and the agreed-upon length of the milling season would be beneficial for all the stakeholders, as the sugarcane would be delivered over a time frame where its quality would still be adequate and thus bring in good revenue. However, some stakeholders fail to comply with the DRD system and the mill has to extend the milling season to get the additional sugarcane. The quality of these late delivered consignments is poor. The sugarcane payment system, which is regulated at sugar industry level, is set up in such a way that the price that is paid depends on the quality of all the sugarcane that is delivered throughout the milling season. This implies that growers who deliver their sugarcane within the agreed time frame are also reimbursed according to the adjusted lower price. Consequently, the incentive to comply with the DRD system is low. The local mill area cannot change the payment system to ensure compliance with the DRD system and the agreed-upon length of the milling season because the cane payment system is regulated at sugar industry level. The costs of solving this issue are high.
- Equally, the tragedy of the commons (Hardin, 1968) impacted on the system studied and provides a further reason for the challenges of facilitating systemic improvements. The stakeholders I engaged with were already very committed to the milling area, but besides

their voluntary work for the benefit of the milling area they also had their own commitments. Their resource and time constraints and the fact that others were not as committed to the system, but basically benefited from the free-ride effect, could explain why the project did not materialise as intended. The stakeholders probably prefer that the system should remain the way it is, rather than investing additional effort for the benefit of others.

- The game theory example of the prisoner's dilemma (Rapoport, 1974, Goetze, 1994) is another possible explanation for resistance to change and the difficulties encountered with change facilitation. Stakeholders might prefer the system to stay the way it is. They may fear that should they decided to 'cooperate', in this case seek opportunities that would improve the system as a whole, their counterparts may decide to 'betray' them, which would imply that some stakeholders could lose their competitive advantage or that the collaboration partner could disadvantage them. Even in a situation where both parties would gain absolutely, an expected difference in the relative gain could prevent the realisation of change. One party would feel disadvantaged, and would not agree to change. Especially the existence of miller-grower fragmentation suggested that the stakeholders might rather hold back instead of collaborating with each other, although from a logical point of view collaboration seems to be much better for the system. Collaboration requires trust.
- Power is another component that can impact on change realisation. Some of the stakeholders may have lacked the power to address inefficiencies or first needed approval from a higher hierarchical level. The stakeholders need to be capacitated to make change happen. Power issues were at play in this project, but they seemed not to be critical in preventing change, because the powerful stakeholders were involved in the change process.

The sugar industry is complex and has elements of a complex adaptive system. However, the difficulties encountered with change realisation suggest that the sugar industry is not a complex adaptive system in the sense that it fully allows for decentralised decision-making and local optimisation. It is rather a resilient and resistant system with hierarchical decision making that follows set regulations and rituals. So far, these characteristics have allowed the sector to survive, but from a complexity perspective it is argued that the more robust a system is, the less able it is to deal with external changes. Given a time of constant and rapid change, poor ability to react to these changes is concerning. Many traditional systems are confronted with this challenge. In addition, the resilient and resistant nature of the sugar industry, like other traditional systems, was possibly a further reason for the lack of change implementation in this study. Consequently, from a complexity thinking perspective it is proposed that the sugar industry and other traditional industries should reconsider their hierarchical structure. They should consider embracing more characteristics of complex adaptive systems. However, this might be somewhat difficult, since it is unlikely that the leaders of a hierarchical system would be willing to rethink the system in a radical way, as this would most likely imply the loss of power. Consequently, a restructuring of this nature would either result from the initiative of people on the ground or there might be a change in circumstances or conditions that "force" the system to redefine itself. Furthermore, a market perspective states the importance of competition. This perspective argues that, in the long term, competition within the sugar industry is better compared to its current hierarchical and socialised structure. It further claims that competition will assist the sugar industry to address many of the current inefficiencies. Industry

stakeholders need to consider these perspectives and should reflect on their current way of operating. However, the exploration of this perspective was outside the scope of this study.

### 3.3 Reflection on the original hypothesis

This project clearly demonstrated that the original hypotheses might be insufficient or inappropriate. It is therefore critical to constantly reflect on the adequacy of the original hypotheses and to revise them as the project proceeds. In addition, new hypotheses that emerge during the course of a project need to be taken into consideration.

For example, hypothesis two *“if the need for change is seen, change will happen”* did not materialise as I had expected because it was based on the assumption that stakeholders are rational. The fact that stakeholders do not always act rationally needs to be taken into consideration when change facilitation is attempted. Likewise, hypothesis three *“If stakeholders know about inefficiencies in the system, can quantify them and perceive them as relevant, they will be incentivised to solve the inefficiency and to collaborate”* turned out to be invalid. The stakeholders knew, for example, about the losses caused by non-compliance with the DRD system in combination with insufficient grower feedback. They acknowledge the significance of the inefficiencies, yet a project to improve the feedback was not undertaken. In addition, hypothesis one *“a comprehensive understanding of a system will facilitate change”* and six *“there are better ways of handling present issues and this will facilitate change”* need to be applied with caution. The VSM diagnosis led to a comprehensive understanding of the system. The stakeholders approved the adequacy of the diagnosis, confirmed that the entire process had helped them to understand their system better and outlined possibilities to address the shortcomings that were detected, yet change was not realised. Furthermore, the fourth hypothesis *“if I offer myself as a resource to the system to assist with the handling of any issue without requesting any reimbursement, the offer will be taken up”* turned out to be invalid and needed to be revised.

The experiences gained in this project resulted in three new hypotheses. Firstly, *“the costs of solving inefficiencies are a crucial driver for change. Only if these costs are lower compared to the benefits of a changed system, will change happen.”* Stakeholders are open to change as long as it does not cost them anything. As indicated above, costs are not necessarily monetary, but often stem from the underlying aspects that strongly impact on a system. Consequently, the costs of solving a problem are mostly not an economic problem, but a social problem.

Secondly, *“there is more potential for an intervention where there are more committed and proactive stakeholders”*. This hypothesis is based on the assumption that an increase in committed and proactive stakeholders would prevent the currently committed and proactive stakeholders from being overburdened. This would free additional capacity to engage in improvement initiatives, such as this project. At the moment, the active stakeholders are too tied up and lack the capacity to really engage in any additional project.

Thirdly, *“if stakeholders from within a system approach a change facilitator, change is more likely to happen”*. This hypothesis is based on the assumption that only once the need to address an issue becomes so pertinent that stakeholders seek help, can the change facilitator make a valuable input.

Nevertheless, the original hypotheses still have merit, such as *“a comprehensive understanding of a system will facilitate change”* or *“if the need for change is seen, change will happen”* or *“there are better ways of handling present issues and this will facilitate change”*. They are beneficial conditions that support change, yet they are not sufficient to cause change to materialise.

The lack of change could also indicate that the fifth hypothesis *“all actors that matter are visible to me and I have involved them in the study”* was not fulfilled. For instance, there might have been an additional stakeholder group (e.g. miller, grower or haulier subsystem), who would have been able to support the realisation of an intervention, but this group was not considered. This highlights the need to continuously reflect on who needs to be involved in a study and to re-evaluate your boundaries.

### 3.4 VSM and change implementation

This project has certainly shown the outstanding diagnostic competency of VSM. The relevance and adequacy of all outcomes of the VSM diagnosis was repeatedly confirmed by the stakeholder. Consequently, VSM has great potential as a diagnostic tool and its use for analysing and better understanding a complex system is encouraged. The VSM diagnosis has even brought underlying patterns to the surface, such as miller-grower fragmentation, power shortcomings, communication shortcomings, mistrust, poor relationships and the stakeholders' diverse perceptions and objectives. This ability of VSM, however, probably resulted from combining it with a qualitative approach that focused particularly on underlying soft issues. Since VSM may not be able to fully reveal and measure the impact of social issues, its combination with qualitative methods that pay particular attention to underlying soft issues and patterns is strongly recommended. For this reason, VSM could also be combined with methodologies that particularly focus on these aspects, such as Soft Systems Methodology (Checkland and Poulter, 2006), which explores the underlying patterns, different views and present power and cultural issues impacting on a situation.

Despite revealing underlying social patterns, the lack of change implementation suggests that these underlying patterns may not have been adequately considered or addressed. Models such as VSM seem unable to adequately reveal and react to these deeper patterns. Failure to address them prevents the system from changing. This highlights the need to combine VSM with other methodologies, especially in cases where resistance to change seems to predominate and where the time, capacity and commitment of stakeholders are limited. I submit that given the buy-in and support from key stakeholders in the system, in combination with enough stakeholders who are committed to working with the change facilitator and whose opinion and contribution is accepted by other stakeholders in the system, the VSM diagnosis alone might have been a sufficient basis for improvement. Nevertheless, possibilities of strengthening VSM's ability to deal with underlying patterns need to be explored.

In addition, the VSM diagnosis did not explain why no change happened and why the stakeholders behaved differently compared to what was originally expected or expressed as desirable by the stakeholders. Again, models such as VSM are not intended to explain this. The core purpose of VSM is to reveal the deficiencies in a system and the possibilities of how a viable system should be built up. For an explanation of why a system cannot be transformed from a deficient to a more viable state, other theories, such as the tragedy of the commons, market failure of public goods or the

prisoner dilemma need to be considered. They also strengthen the VSM diagnosis of the underlying social aspects, as they stress the importance of taking these aspects into consideration when seeking an intervention in a complex system.

This discourse shows that the first research question *“How can a VSM diagnosis assist in the understanding and handling of complex sugarcane production and supply systems?”* can be answered as follows:

VSM, with the assistance of qualitative research methods focusing on the soft aspects in the system, provided a comprehensive understanding of a complex sugarcane production and supply system. However, VSM’s ability to handle the deficiencies detected could not be approved. This shortcoming presumably resulted from the specific circumstances of this project, rather than an inadequacy of VSM. The competency of VSM regarding complexity management is stated in the literature. Nevertheless, it is proposed that VSM be combined with other methodologies and concepts to improve its competency in revealing the deeper patterns in a system, to extract possible barriers to change and to support change implementation.

### **3.5 Further insights concerning intervention in complex systems**

The study revealed the inconsistency between what people say and what they do. Several stakeholders confirmed their workshop attendance, but did not turn up; or they said that they would take an issue further that had been discussed, but when I checked, the issue had not been brought up at the relevant meeting. In addition, stakeholders chose to work on communication and information provision and confirmed in the first meeting that this was a serious issue and that especially the lack of feedback was problematic. However, in the course of the project it turned out that the lack of feedback was not a major concern this year due to the greater sugarcane supply. This also suggests that there could have been a gap between what the stakeholders said and their actual conscious or unconscious agenda. This clearly indicates a need to probe deeper. Why did the stakeholders not attend the workshop? Why was the issue not brought up? Is this issue relevant? What is the real issue? What is really critical for the stakeholders? Are there other underlying issues that are more relevant and that explain this behaviour of the system? As already mentioned, deeper probing was limited in this study.

Likewise, the stakeholders’ description of an issue, such as communication or the miller-grower relationship, differed when it was discussed in a workshop and in a one-to-one interview. The stakeholders collectively seemed to behave differently from how they behaved as individuals. This is explained by Granovetter’s (1978) threshold models. Consequently, workshop outcomes need to be verified through interviews and vice versa through a process of triangulation. One should neither rely purely on workshop outcomes nor on interviews. A combination of both provides a more holistic view and a better understanding of the dynamics of the system. In addition, the question of whether a group has a different value system than an individual should be researched. However, even a triangulation procedure may not be able to detect inconsistencies between people’s explicit statements (whether in a group or alone) and their actual behaviour.

## Chapter 4 Conclusion

The project did not achieve the intended results as recommended by the initial research, and could therefore be described as a failure. However, problems with change implementation are common when seeking an intervention in complex systems. Consequently the learning that emerged from reflecting on the outcome of this project added more value to the topic of intervening in complex systems than a project report would have done where everything went according to plan. The experiences from this project are relevant to any other complex multi-stakeholder setting, since a sugarcane supply chain is just an example of a complex multi-stakeholder setting.

A core objective of this project was to explore how a VSM diagnosis assists in the understanding and handling of complex sugarcane production and supply systems (research question one). The project confirmed the outstanding capacity of VSM to facilitate a holistic understanding of the system. However, it must be realised that one will never be able to fully understand a complex system. Consequently, VSM is one framework among other tools and techniques that lend themselves to facilitating understanding and sense-making, and should thus be used. In applying VSM one needs to be aware that one cannot detect all the relevant elements and issues of the system ex-ante and then define and implement a solution for them. As the VSM user seeks to implement recommendations derived from the VSM diagnosis, further issues that need to be addressed will emerge. Aspects of the system that have thus far not been recognised, for example additional sub-systems or the need for a better connection between sub-systems, will surface, therefore the understanding and exploring of the system is an ongoing process.

When using VSM it must be ensured that the greater system in which it is embedded is adequately considered, including the underlying deeper social aspects. It is also strongly proposed that VSM be combined with qualitative research methods that specifically focus on underlying social patterns, or with methodologies such as soft systems methodology that explore the soft aspect of the system.

Despite its merit in supporting understanding, VSM alone appears to be insufficient to bring about change implementation given the existence of resistance to change, stakeholders who do not seem to be motivated to address sensitive issues and underlying obstacles that prevent change. VSM's ability as a change driver is questioned. In addition, VSM does not cater adequately for the difference between what people say and what they do.

Given the course of this project, research question two *“how can the shortcomings that surfaced during the VSM diagnosis be addressed?”* and research question three *“what approaches to facilitating change are likely to promote implementation of recommendations from a VSM analysis by stakeholders?”* remained unanswered. It is, however, suggested that addressing the underlying social aspects in a system and considering the costs of solving inefficiencies is critical to facilitating change.

The following aspects are proposed as possible reasons for the lack of improvement and change realisation. These factors need to be taken into consideration when dealing with change in complex systems.

The project clearly showed that the incentive, viz. the benefits of a changed or more efficient system, must have been lower than the costs of solving the current inefficiency, or these costs must

have been higher than the actual costs of the inefficiency, otherwise change would have happened. The costs of the inefficiency may have been low because the stakeholders did not really experience them, since they belonged to potential income rather than expenses. However, change is not only dependent on the quantified monetary costs of the inefficiency, but to a large extent on the deeper underlying patterns, such as norms, rituals and traditions and especially the soft issues that are so challenging. The cost of solving inefficiency is mostly not an economic challenge, but a social challenge, and the monetary cost of inefficiency is not always the driver of change. This argument is supported by the prisoner's dilemma, the tragedy of the commons and market failure of public goods. These theories explained why change, despite seeming rational and supported by the VSM diagnosis, was not realised. Change facilitators are required to take these deeply embedded patterns, especially the underlying soft issues, into account. They also need to acknowledge that any change causes winners and losers, and should thus explore possibilities of compensating the disadvantaged party or parties.

Likewise, power plays an important role in change facilitation and it is important to consider whether stakeholders have the power to make change happen.

Time constraints of key stakeholders, the presence of lethargy and the questionable motivation of the stakeholders in addressing sensitive issues certainly compromised the intended intervention. The project clearly demonstrated that change cannot be pushed. One cannot force a system to change, no matter how beneficial it would be. Change needs to be initiated from within the system. A change facilitator, no matter how competent, cannot facilitate change when the system is not ready for change. Consequently, a change initiative should only be conducted when the system demands it in order to ensure sufficient commitment for change to happen.

Besides providing reasons for the lack of change implementation, this report also offers lessons one should bear in mind when dealing with change in complex systems.

Original hypotheses still have merit, but lack sufficiency and should be complemented by the following three new hypotheses that are based on the above discourse:

- *"The costs of solving inefficiency are a crucial driver for change. Only if these costs are lower compared to the benefits of a changed system, change will happen."*
- *"There is more potential for intervention where there are more committed and proactive stakeholders".*
- *"If stakeholders from within a system approach a change facilitator, change is more likely to happen"*

This experience emphasises the need to frequently reflect on your initial hypothesis and to challenge your assumptions and revise them as the project proceeds. The diagnosis is ongoing while the change process is being implemented. New hypotheses that emerge during this process need to be taken into consideration. Uncertainty about unintended consequences, which hampers change implementation, further drive the change facilitator to apply a holistic approach that consistently reflects on all potential impacts of interventions and verifies the suitability of the original hypotheses. In addition, continuous reflection on who needs to be involved in a study and a re-

evaluation of the boundaries are essential to ensure that all key stakeholders are involved, which is critical for change realisation.

This project highlighted the differences between the articulated objectives and priorities of the stakeholders and how they behave individually and collectively. This is insufficiently taken into account by the VSM diagnosis and thus, as indicated previously, VSM should be strengthened by methods that are sensitive to such differences. Theories such as the prisoner's dilemma or the threshold model, or methodologies such as soft systems methodology could be used to increase one's sensitivity to these aspects and the underlying social aspects. In addition, triangulation should always be applied and data should be collected from individual interviews and group processes. Furthermore, the need to probe deeper was emphasised, and especially when it comes to what people say privately or when in a collective situation.

Further research should be conducted on strengthening VSM regarding an even deeper understanding of the underlying social aspects of a system and the implementation of improvements, especially as a process instrument. In addition, the adequacy of the lessons learned and the new hypothesis that emerged from this project should be tested and it should be investigated how change implementation can be improved.

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