SHORT COMMUNICATION

A FARMERS MARKET AT THE LOCAL SUGAR MILL: LEAN VERSUS AGILE

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Abstract

Despite attempts by many sugar industries to improve their supply chains from the field to the mill, to date the number that have been successful have been limited. This tendency, in comparison to automotive and electronics industries, where supply chain improvements have made significant impacts since the 1970s, is a cause for concern and raises the question of whether the supply chain improvement programmes and principles from other industries can simply be applied in a sugar industry. This short communication reviews the fundamentals of supply chain thinking, in terms of *lean* and *agile*, and relates these to sugarcane production and processing. Important contradictions in the sugarcane supply chain, with respect to lean and agile principles, are highlighted and some assumptions that are currently widely supported by industry are challenged. Well accepted performance metrics used in the sugar industry are reviewed and several limitations are highlighted. The short communication concludes by calling for a comprehensive multi-disciplinary review of the sugarcane supply chain and the derivation of additional performance metrics that can be used to better quantify system efficiency.

Keywords: sugarcane, supply chain, lean, agile, performance metric

Introduction

It is generally accepted that in the new millennium competition will be between supply chains as opposed to companies (Christopher and Towill, 2001). Ever since Toyota Production Systems introduced the term *lean* supply chain in the 1970s (Sugimori *et al.*, 1977), many industries have made innovative attempts to reduce wastage, while maintaining high quality standards. Lean is about doing more with less and works well in a supply chain with high volume, low variety and good prediction (Agarwal *et al.,* 2006). The term *agile* was introduced to suggest that certain supply chains are not appropriate when lean, because of the business environment driving them, such as rapidly changing markets. Agility can be defined as having the ability to respond rapidly to changes in demand, both in terms of volume and variety (Christopher, 2000). van Hoek *et al.* (2001) elaborate on the concept of *leagile*, where a supply chain will have distinctive lean and agile components with a well defined couple-point. Leagile supply chains are appropriate when a business environment demands contradictory attributes within the product being supplied, such as high variety at low cost, or high throughput under high risk.

Performance metrics (Kleijnen and Smits, 2003) are quantifiers describing aspects of the full supply chain, and can be used for benchmarking and the effective design of continuous improvement management systems, such as six-sigma (Raisinghani *et al.*, 2005). Performance metrics can differ significantly between lean and agile chains. Typically, a lean supply chain will use metrics such as turn-around time and cost per unit product, whereas in agile supply

chains, metrics such as quality, response time and service level may be more appropriate (e.g. Christopher and Towill, 2001).

During good weather conditions in July a sugarcane supply chain should ideally be as lean as possible; however, in rainy conditions or during a crises, such as frosted cane, agile resources are ideally needed to minimise losses. Many sugarcane supply chains in South Africa generally function at high levels of over-capacity (i.e. agile); e.g. 570% mechanical harvesting capacity at Noodsberg (Le Gal *et al.*, 2008), 167% transport capacity at Sezela (Giles *et al.*, 2005), and between 113% and 185% capacity over the full chain, from harvesting to exhaustion, at Komati mill (Stutterheim *et al.*, 2008). These levels of over-capacity are likely to be attributable to high risk levels and unco-ordinated decision-making among stakeholders. Little evidence exists that any supply chain has been deliberately over-designed to cope with risk; likewise, several surveys have revealed strong links between over-capacity and the multi-decision-maker environment (e.g. Giles *et al.*, 2005; Le Gal *et al.*, 2008), which often leads to over-capacity being interpreted as wastage. The aim of this short communication is to briefly evaluate the South African sugarcane supply chain configuration against lean and agile principles and to provide some pointers towards appropriate performance metrics that may help to redesign and better manage the supply chain.

Comparison of lean and agile attributes for sugar production

Table 1 summarises a number of lean and agile supply chain attributes and depicts those associated with the South African sugar industry. It is evident that lean and agile fundamentals appear mixed. Sugar production in South Africa is characterised by (i) inconsistent volumes and quality as a result of high production risks (such as climate, break-downs and labour shortages), (ii) multiple decision-makers and (iii) rapid cane deterioration. The abovementioned attributes typically demand agile supply chain principles and appear to dominate the upstream parts of the supply chain. However, a downstream commodity-type market demands lean principles, which does suggest a high likelihood of conflicting interests when supply chain design and planning occurs. The current performance metrics used to benchmark and promote best management practices in the supply chain may therefore be contradictory, and may promote unnecessary conflict. A leagile approach may need to be considered.

Table 1. Summary of attributes commonly found in lean supply chains (from Agarwal *et al.*, 2006). Ticks indicate whether the sugarcane supply chain in general demands a lean or an agile approach.

Lean supply chain attribute	Lean	Agile
Market demand is relatively predictable	✓	
Product variety is low	✓	
Product life cycle is long	✓	
Customer is driven by cost	✓	
Profit margins are low	✓	
Physical costs dominate chain	✓	
Eliminating waste is essential	✓	
Constant product quality is maintained		✓
Constant product volume is maintained		✓
Central management and control		✓
Value density is low	✓	
Product is durable	✓ (sugar)	✓ (cane)
Production risk is low		✓
Low level of flexibility is required		✓

Figure 1 summarises different supply chain components and typical multi-component performance metrics used to quantify and manage these processes. Noteworthy, with the exception of sugar quality, few current metrics quantify the holistic efficiency of the supply chain. Sugar quality is a suitable metric to quantify the value chain, but fails in other important dimensions of the supply chain, such as production cost and efficiency, risk mitigation, quality of management and level of collaboration. Without the appropriate quantifiers to benchmark supply chain efficiency within all its important dimensions and as one business entity, any attempts to improve the supply chain are likely to fail.

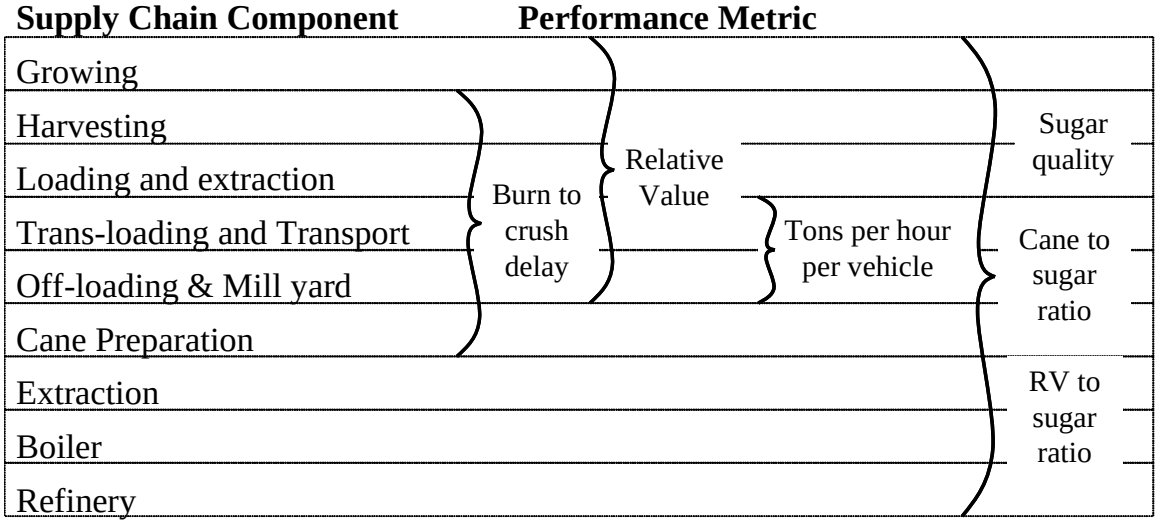

Figure 1. Sugar supply chain components and current performance metrics used to describe composite processes in the chain (based on the framework of Stutterheim *et al*., 2008).

Discussion and Conclusions

The sugarcane supply chain remains complex, while compounding both lean and agile attributes. Current performance metrics are limited, which creates opportunities for conflict, and prohibits innovation and appropriate management and incentive systems. However, to establish suitable performance metrics will require complex systems analyses. Wrong metrics will result in wrong incentives and stakeholders chasing the wrong goals. Good performance metrics must be quantitative, simple, multi-dimensional, visible and transparent (Coyle *et al*., 2003). Good performance metrics will enable stakeholders (i) to agree on a certain level of risk and thus design the supply chain to be resilient, (ii) to benchmark different management and supply systems and to design continuous improvement management systems, and (iii) to align the objectives of all stakeholders in the chain.

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