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THE ROLE OF SUPPLY CHAIN MANAGEMENT IN INCREASING THE COMPETITIVE ADVANTAGES OF VIETNAMESE COFFEE PRODUCTS: A SYSTEMS THINKING APPROACH

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CONTENTS

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ABSTRACT

Supply chain management (SCM) has been receiving greater attention among academics and organizations and is viewed as a potential source of increasing competitive advantages. Thus, the aim of this study is to investigate the role of supply chain management in order to enhance the competitiveness of Vietnamese coffee. This topic was chosen because there has been little previous research done to study the competitive advantages of coffee products in general and of applying systems thinking in order to enhance the competitive advantages of Vietnamese coffee in particular. This research discovers suitable sub-system models for different chains of the whole coffee supply chain. Interrelationships between these sub-systems and their leverage points are also explored and identified in order to reduce cost, increase quality and upgrade the competitive advantages of Vietnamese coffee products. This research focuses on an understanding of supply chain management in order to enhance the competitiveness by asking the following research questions: What are the main drivers and barriers in the supply chain towards improving the competitiveness of Vietnamese coffee products? What is the most appropriate systems model for each sub-system in the coffee's supply chain?, and How can systems thinking and modelling be used to manage a whole supply chain more effectively by reducing cost and enhancing the competitiveness of coffee products internationally? Initial findings of the study consist of three sub-system models (including sub-systems of production_chapter 2, processing_chapter 3, and export_chapter 4) to explore relationships among different variables in production, processing and export stages. A causal loop diagram for the whole supply chain was then

developed (chapter 5), which helped to identify the overall relationships of the Vietnamese coffee supply chain from production to final customers. In addition, a sequential approach, by combining two established modelling techniques (Causal loop diagram and Bayesian Belief Networks - BBNs) was applied to identify the leverage points in the Vietnamese coffee supply chain for increasing the competitive advantages of the product (chapter 6). Finally, potential interventions were implemented in the coffee supply chain management philosophy for increasing the competitiveness of coffee products, and directions and recommendations for future research are also discussed.

DECLARATION

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1. Introductory Background

Coffee has been cultivated and harvested in over 80 tropical nations (Schmitt, 2006). Of some 80 countries that produce coffee, three countries alone have in recent years produced approximately 57% of the world's coffee: Brazil is leading with about 32%–34%, followed by Vietnam and Colombia with around 13% and 9% respectively (IOC, 2011). Coffee plays a vital role in the less-developed countries of Africa, Southeast Asia and Latin America (Austin, 2012; Talbot, 2004). It contributes as a pivotal agent of development, generating cash returns to the balance of payment in national economies (UNCTAD, 2009). Coffee production also provides employment for both men and women in rural areas because much manual labour is required in the producing, weeding as well as harvesting processes. In addition, an estimated more than 25 million small farmers in the world are dependent directly on coffee as the primary source of their income (Donald, 2004).

In international trade, coffee is not only the most valuable tropical agricultural product, but also has recently become one of the most crucial export items in the world market, accounting for an estimated $15.5 billion in 2009/2010 (IOC, 2011). Coffee is one of the most highly valued primary sector products exported by developing countries, after oil (Foundation, 2012; Talbot, 2004). In many developing countries, coffee is a unique commodity, because coffee exportation not only contributes a major proportion of gross domestic product, but also a vital source of foreign exchange earnings for many governments, such as Burundi with about 60%, Ethiopia 33%, Rwanda 27% and

Honduras 20% (IOC, 2011). Exporting coffee is a good strategy for less-developed nations, which can take advantage of the fact that they have favourable conditions for producing coffee and that developed nations are not competitive in this sector – richer countries prefer to purchase coffee products as they earn considerable profits from its distribution and consumption.

Located in a tropical region, Vietnam's economy has achieved an agricultural economic dominance. Since the 1980s, with a reformed policy (Doi Moi), Vietnam has made significant achievements in agricultural production. It moved from a poor nation with a food shortage to a large exporter of some agricultural products in the world market such as rice, coffee, tea, sugarcane, soybean, pepper, cashews and rubber (Luong *et al.*, 2006). Of these agricultural products, coffee is one of the most valuable export items, accounting for some 12% of Vietnam's total export values (equal to more than USD 1.2 billions), second only to that of rice exports (Luong and Tauer, 2006).

Vietnam is highly competitive as a coffee producer and exporter due to favourable climatic and environmental conditions, low labour costs, low production costs and high yields. Vietnam's coffee production has been developing fast; while in the 1980s Vietnam had only about 14000 ha of coffee, produced 6500 tons and was ranked the 16th of producers and exporters in the world, coffee plantings in Vietnam now cover slightly more than 500,000 ha, producing a total of 1,000,000 tons (Ha *et al.*, 2008). Therefore, since 2000 Vietnam has remained as the second largest coffee producer and exporter in the world (after Brazil), with about 15% of world market share (Ha and Shively, 2008). However, the gap between Vietnam and the main producer Brazil is still considerable in both market share and export volume. While Brazil exported about 2 million tons in 2010, Vietnam exported less than half of that (around 860 thousand tons) (Austin, 2012). More

importantly, while Brazil focuses mainly on Arabica coffee with high value, high quality and high competitiveness, Vietnamese exported coffee is principally Robusta coffee which has low value, low quality and low competitiveness.

Vietnam exports both Arabica and Robusta coffee, but it is known as the biggest Robusta coffee bean exporter in the world, with a world market share of 43% and accounting for 90% of Vietnam's coffee (AGROINFO, 2008); this kind of coffee is considered less valuable than Arabica. Robusta coffee often achieves lower prices than Arabica coffee in the world market, as the taste of Arabica is preferred by most consumers. Therefore, the competitiveness of Vietnam's coffee currently is lower than other countries' (Dung *et al.*, 2007). Almost all Vietnamese coffee (95%-97%) is consumed on international markets, only the small remaining percentage is consumed domestically (Luong and Tauer, 2006). As a result, its price is dependent on the fluctuating world market prices. In addition, about 85%-90% of coffee production is carried out by small farmers who own less than 3 hectares, while state owned farms cultivate around 10-15% of total areas (Tran, 2007). The difficulty in improving the quality of coffee could lead to decreasing competitiveness of Vietnamese coffee in the future. However, although Vietnam is the second largest coffee bean exporter in the world market (Ha and Shively, 2008), its coffee fetches lower prices than those of the world average. This can be explained by its lower quality due to poor processing, drying facilities and post-harvest technologies.

Coffee is enormously valuable to Vietnam as well as the economies of many less-developed countries. Therefore, to date, many attempts have been made to investigate the competitiveness of coffee products in different countries. Numerous studies have focused on how to increase the competitiveness of coffee products in the world market by

exploring the role of firm networks under conditions of unstable linkages between knowledge inputs and coffee products outputs (Grant, 1996). Others have investigated ways to increase the competitiveness of the coffee product by upgrading quality and discovering new market niches (Pelupessy *et al.*, 1999; Villas-Boas, 1995). Improving coordination along the coffee chain has also been focused on by many researchers in order to improve the competitiveness of coffee (Muradian *et al.*, 2005). However, none of these have specifically focused on investigating how to increase the competitiveness of coffee products by exploring a management systems model for different components as well as a general systems model in supply chains. Therefore, this thesis focuses on two aspects of supply chain management model: developing causal loop diagrams for the coffee supply chain as well as its sub-system models, and analysing the factors influencing the competitive advantages of Vietnamese coffee.

1.2. Systems thinking in supply chain management

Systems thinking has been applied in almost all fields, e.g.: health (Best *et al.*, 2003; Hamdani *et al.*, 2011; King *et al.*, 2006; Swanson *et al.*, 2012; Trochim *et al.*, 2006), environment (Bina, 2008; Roome, 1992), agriculture (Bawden, 1991; Bosch *et al.*, 2007; Gibbon, 2002; Sandall *et al.*, 2011), education (Arndt, 2006; Assaraf *et al.*, 2010; Banathy, 1999; Ison, 1999), production (Bey *et al.*, 2006; Marmor, 1983; Seddon *et al.*, 2007), project management (Baskerville *et al.*, 1996; Jackson, 1995; Kapsali, 2011; Mawby *et al.*, 2002), and supply chain management (Davis, 1993; Georgiadis *et al.*, 2005; Graham *et al.*, 2005; Oehmen *et al.*, 2009; Vlachos *et al.*, 2007).

The application of systems thinking to supply chain management can be used to analyse various scenarios. There are already few publications using systems thinking in supply

chain modelling, but most of them were related to forward logistics. Forrester (1997) introduced a systems thinking methodology in the early 1960's as a modelling and simulation methodology for long-term decision-making in dynamic industrial management problems, and he also developed a model of supply chains as one of his early examples of the systems thinking methodology. Towill (1996) used systems thinking for predicting and prioritizing methods of re-engineering the chain in order to achieve enhanced performance when viewed from the perspective of all "players" in the supply chain. The outputs of the proposed model are industrial dynamics models of supply chains. Minegishi *et al.* (2000) used systems thinking to improve the understanding of the multi-relationships between the economic actors and the control variables in the whole supply chain of food industry. They present a generic model and then provide practical simulation results applied to the field of poultry production and processing. Ge *et al.* (2004) applied systems thinking for the improvements in information sharing among different parts of the chain and the structural changes in information flow. They analysed the causes of the dynamic behaviour of the system and the sources of amplification from the downstream to the upstream of the chain. Vlachos et al. (2007) applied system thinking methodology to develop a causal loop diagram in a reverse supply chain. In this study, they tackled the development of efficient capacity planning policies for remanufacturing facilities in reverse supply chains, taking into account not only economic but also environmental issues, such as the take-back obligation imposed by legislation and the "green image" effect on customer demand (Vlachos *et al.*, 2007). Oehmen, Ziegenbein et al (2009) examined a system-oriented view of supply chain risk management. In their study, two new interrelated modelling approaches are proposed: One is a supply chain risk structure model to describe the system that determines the

causes and effects of supply chain risks, i.e. the factors and their relationships. Another model is the supply chain risk dynamics model, which is used to model the possible dynamics of risk development. In addition, how these models integrate into a supply chain risk management process framework is also demonstrated in this study (Oehmen *et al.*, 2009). In their empirical work on supply chain, Moon and Kim (2005) used systems thinking to examine relationship management among businesses in supply chains. Their research focused on how individual systems thinking ability impacts on the supply chain.

1.3. Competitive advantage through supply chain management

The term 'competitive advantage' was first introduced by David Ricardo, an economist in 1817. This theory pointed out that "nations should specialize in production of and export the commodities in which its absolute disadvantage is smaller (this is the commodity of its competitive advantage) and import the commodity in which its absolute disadvantage is greater" (Appleyard *et al.*, 2008). Today, this theory has been applied in many different sectors to identify the competitive advantages of a country, such as international trade (Dornbusch *et al.*, 1977; Reimer *et al.*, 2010; Vixathep, 2011), management (Astolfi *et al.*, 2012; Luo *et al.*, 2011), marketing strategy (Okubo, 2009; Smith, 1994), and investment (Friedman *et al.*, 2010; Le, 2010; Odhiambo, 2010), to name just a few.

Supply chain management is critically important to competitive positioning (Porter *et al.*, 1985). It is often used as the popular strategy for increasing organizational competitiveness and product competitiveness in the twenty first century. It has become an essential prerequisite for staying competitive in the global race and for increasing profitably. Many organizations have begun to recognize that supply chain management

is the key to building a sustainable competitive edge for their products and/or services in an increasingly crowded marketplace (Cucciella *et al.*, 2012; Groznik *et al.*, 2010; Li *et al.*, 2006a). There are already a number of publications focusing on competitiveness via management of the supply chain. The publications have focussed on different aspects of competitive advantages in the supply chain. For example, Martin Christopher (2000) and Li *et al.* (2006b) proposed that competition is to be found within the supply chain, so supply chain management is a potentially valuable way of protecting competitive advantage. They concluded that a higher quality of supply chain management might lead not only to enhancing the competitive advantage of the product, but also to improve organizational performance. Chan *et al.* (2005), and Narasimhan *et al.* (1998) focused on correlation among stakeholders in the supply chain. They concluded that the correlation among stakeholders contributes to the competitive advantage of the manufacturer in improved business processes and well-organized production set ups, leading to shorter cycle times and escalating throughput (Chan and Esra Aslanertik, 2005; Narasimhan and Jayaram, 1998). This correlation may lead to substantial cost and cycle time reductions, and as a result of this, competitive advantage will increase due to changing customer demands and increasing customer service levels. Lambert *et al.* (2000), and Spekman *et al.* (2002) focused on the key supply chain members, because they play a vital role in creating increasing competitive advantage, and the profitability of a product requires integrating business processes (Lambert and Cooper, 2000; Spekman *et al.*, 2002). Shams-ur Rahman (2002) claimed that understanding the relationship between cause and effect in the dynamic nature of supply chains is critical to the formulation of supply chain growth strategies. He also argued that effective supply chain management is the competitive strategy that has the most potential to reduce costs further (Rahman, 2002).

1.4. Coffee supply chains

The coffee supply chain has been studied by numerous researchers in different organizations. Ibrahim and Zailami (2010), for example, claimed that the coffee industry, like other industries, cannot function effectively without a supply chain. For coffee, the chain is usually complicated and differs from country to country. However in general it includes: growers, processors, intermediaries, government agencies, exporters, dealers/brokers, roasters and retailers. They also argued that if the coffee industry had an efficient and effective global supply chain, it would be able to control and ensure the quality of its coffee exports (Ibrahim *et al.*, 2010). In addition, Topik and Samper (2006) claimed that the coffee supply chain, like other supply chains in the agricultural industry, is a dynamic historical construct that changes over time in respect to both technical organisations and the social organizations of linkage between cultivation, harvesting, transportation, processing, and distribution (Topik *et al.*, 2006). The coffee supply chain is structured in an articulated and complex web of relationships that links production and consumption, where information asymmetries and market power are pervasive problems (Catturani *et al.*, 2008). Viere, Schaltegger et al (2007) argued that supply chain information management does not only support corporate decision making and eco-efficiency measures of coffee product, but can also be used to analyse the financial relevance of the environmental issues in various coffee supply chain steps (Viere *et al.*, 2007).

1.5. Conclusion and research gaps

In summing up the empirical evidence available in the literature, it is evident that there has been no previous work that examines ways to upgrade the competitiveness of product

by using systems thinking approaches to management of the supply chain, especially in the coffee supply chain. Accordingly, this research has identified the opportunities to use a systems thinking approach and its associated tools and methods to explore the role of supply chain management to reduce cost, in order to increase the competitiveness of Vietnamese coffee products.

The following research gaps remain to be addressed

1. What are the main drivers and barriers in the supply chain towards improving the competitiveness of Vietnamese coffee products?
2. What is the most appropriate systems model for each sub-system in the coffee's supply chain?
3. How can systems thinking and modelling be used to manage a whole supply chain more effectively by reducing cost and enhancing the competitiveness of coffee products internationally?

Therefore, this study aims to:

1. Develop appropriate subsystems model in the coffee supply chain
   + Create a subsystems model for the production stage (Chapter 2)
   + Create a subsystems model for the processing stage (Chapter 3)
   + Create a subsystems model for the export stage (Chapter 4)
2. Develop the causal loop diagram for the whole coffee supply chain (Chapter 5) for enhancing the competitive advantages
3. Identify key success factors and potential interventions in supply chain management for increasing the competitive advantages of Vietnamese coffee (Chapter 6).

1.6. Thesis structure

This dissertation is organised in seven chapters. This chapter (***Chapter one***): the supply chain management relationship with competitive advantages has been presented as a subject along with the gaps identified in the studies of the supply chain management and the systems thinking approach perspective in connection with the aims of this thesis. The fundamentals for the choice of theory perspective were also argued for, as well as the general theoretical framework of the research questions.

Chapter two identifies the factors that directly affect production cost and quality of coffee cherries. In this chapter, a systems thinking approach using causal loop diagrams has been applied to increase the quality and reduce the production cost of coffee in order to enhance the competitiveness of coffee production in the international market. A causal loop model of coffee production in Vietnam, integrating cost, quality and coffee cultivation, has been developed to identify key leverage points, where systemic interventions will be most effective to reduce production cost as well as increase the quality of coffee cherries of production stage.

Chapter three presents the advantages of using systems thinking in the analysis of the coffee processing stage by developing an exploratory causal loop model. This model is intended to equip managers with sufficient knowledge and understanding of strategic management in green coffee processing in order to increase the quality of their coffee beans. The causal loop model also allowed the identification of potential leverage points where systemic interventions will be most effective to increase the quality of green coffee beans.

Chapter four explores a systems thinking approach to identify and analyse the export barriers that the Vietnamese coffee export enterprises are facing in the international markets. Several causal loop diagrams are developed to provide a better understanding of the barriers. Models of general internal and external barriers to the export of coffee are developed to obtain an understanding of the complex relationships between these barriers and how they affect Vietnamese export in the international markets. Various strategies are proposed to reduce the impact of the barriers on coffee export activities.

Chapter five develops causal relationships among different variables that present enablers and outcomes operating within many identified feedback loops. The resulting causal loop model provides coffee supply managers with a snapshot of the dynamic interactions among elements in the coffee supply chain, which helps to identify proactive action in implementing the coffee supply chain philosophy for increasing the competitiveness of coffee products. Based on this review and analysis, recommendations are made regarding the application of the causal loop method in coffee supply chain management.

In ***chapter six,*** a sequential approach that combines two established modelling techniques (Causal loop diagram and Bayesian Belief Networks - BBNs) is applied to identify the leverage points in the Vietnamese coffee supply chain for increasing the competitive advantages of the product. Systems archetypes are identified and sensitivity analysis is used to identify potential factors that would increase the competitive advantages of coffee production.

Finally, ***Chapter seven*** presents the main contributions from both theoretical and empirical perspectives. Discussions are summarized, and limitations to consider in future research are also discussed.

CHAPTER 2

CONTRIBUTION OF THE SYSTEMS THINKING APPROACH TO REDUCE PRODUCTION COST AND IMPROVE THE QUALITY OF VIETNAMESE COFFEE

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Contribution to the Paper	Designed and performed the survey, data analysis and interpretation, wrote manuscript, and acted as corresponding author		
Overall percentage (%)	80		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	8/2/2017

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Nam C. Nguyen		
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Contribution to the Paper	Supervised development of work, manuscript evaluation and correction.		
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Contribution of the systems thinking approach to reduce production cost and improve the quality of Vietnamese coffee

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Abstract: The current trend of increasing cost and declining quality in coffee production has prompted concern among producers because of its potential implication for reducing the competitiveness of their products. The aim of this study is to identify the factors that directly affect production cost and quality of coffee cherries. In this study, a systems thinking approach using causal loop diagrams has been applied to increase the quality and reduce the production cost of coffee in order to enhance the competitiveness of coffee production in the international market. A causal loop model of coffee production in Vietnam integrating cost, quality and coffee cultivation has been developed to identify key leverage points where systemic interventions will be most effective to reduce production cost as well as increase the quality of coffee cherries.

Keywords: coffee production; production cost; quality of production; systems thinking; international markets; business systems; Vietnam.

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Nam C. Nguyen is a founding member of the newly established and internationally linked Systems Design and Complexity Management (SDCM) Alliance in The University of Adelaide Business School. He has been awarded a number of nationally and internationally competitive academic fellowships and research grants (worth more than $1M). He is also a recipient of the prestigious 2011 Australian Leadership Award, a member of the Scientific Board of the Business Systems Laboratory in Italy, the Vice President (2012–2013) of the International Society for the Systems Sciences (ISSS) and the Vice President (2014–2016) of the International Federation for Systems Research (IFSR).

Ockie J.H. Bosch is Professor and Head of the Department of Plant and Soil Sciences at the University of Potchefstroom in South Africa from 1985 to 1993. He is the Head of the Department of Life Sciences of the University of South Africa (dual position) from 1990 to 1993. In 1993, he became the Research Director in Landcare New Zealand, and moved to Queensland in 2000 to become a Professor in Natural Systems at The University of Queensland. From 2002–2011, he is the Head of the School for Integrative Systems at the University of Queensland. In 2012, he moved to the University of Adelaide where he leads the Systems Design and Complexity Management Alliance.

1 Introduction

1.1 Importance of Vietnam as a global coffee producer

Vietnam is highly competitive as a coffee producer and exporter due to its favourable climatic and environmental conditions, low labour costs, low production costs and high yields. Vietnam's coffee production has been increasing over the years. In the 1980s Vietnam had only about 14,000 ha of coffee plantations, and produced 6,500 tons per year (ranking 16th in the world). These numbers have increased significantly over recent years to a current area of around 500,000 ha and a production figure of 1,000,000 tons. Since 2000 Vietnam has remained the second largest coffee producer and exporter in the world (after Brazil), accounting for about a 15% share of the world market (Ha and Shively, 2008). However, the gap between Vietnam and Brazil is still considerable in both market share and export volume. Brazil exported about 2 million tons in 2010 while Vietnam exported less than half of that (around 860,000 tons) (Austin, 2012). More importantly, Brazil focuses mainly on Arabica coffee which has a high value and quality – making them very competitive in the global market. On the other hand, Vietnam exports primarily Robusta coffee, which has a low value and quality – leading to low competitiveness. Vietnam exports both Arabica and Robusta coffee but it is known as the biggest Robusta coffee bean exporter in the world (with 43% of the market share) and this accounts for 90% of Vietnam's coffee (Winkels, 2008). The taste of Arabica is preferred by most consumers which causes Robusta coffee to attract a lower price than Arabica coffee in the world market. According to Ha and Shively (2008), Vietnam's coffee attracts lower prices than the world average even though the country is the second largest coffee bean exporter in the world market. This coffee is of a lower quality due to poor processing, drying facilities and post-harvest technologies.

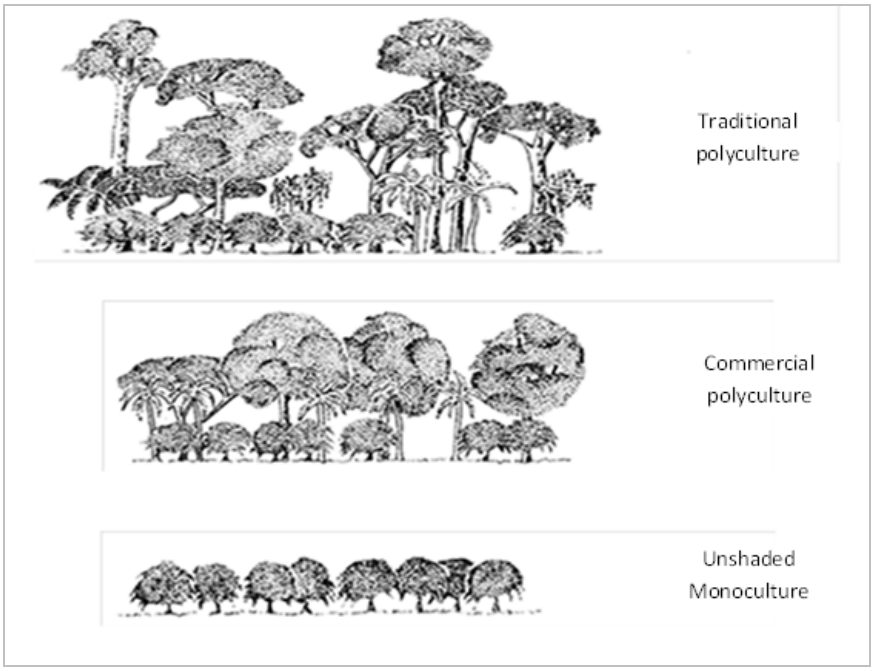
1.2 Nature of coffee production systems in Vietnam

Coffee production is mainly a 'family' activity on small farms and in households where this primary production is not assisted by technology and is very labour intensive. Although the productivity of coffee is high, the increasing production cost and low quality are common problems for most coffee producers in Vietnam. Since the international coffee price crisis that started in 1998 and worsened during 1999 (Lopez-Garcia et al., 2008), the coffee producers in Vietnam have been facing serious

problems and have struggled to maintain production. In many cases, the commercial price does not cover production costs leading to a loss of income and eventual crop replacement.

In Vietnam, coffee is cultivated under several structurally different production systems. These systems form a continuum from the more traditional with higher diversity in the structure and composition of the shade canopy, to those with reduced shade and intensive management. There are three main coffee production systems in Vietnam, distinguished according to the management level and structural complexity: the rustic system (traditional poly-culture), the traditional system (commercial poly-culture), and the unshaded monoculture system (Figure 1).

Figure 1 The three main coffee growing systems in Vietnam



Source: Adapted from Moguel and Toledo (1999)

1.2.1 Rustic system (traditional poly-culture system)

The rustic production system is commonly found in the remote mountainous areas in the central highlands of Vietnam. These areas are inhabited by minority groups where communication is poor. The most striking characteristic of this system is the use of the natural forest to provide shade for the coffee bushes. In this system, only the lower stratum of the forest is removed; as a result the original tree cover is maintained and coffee bushes are inserted underneath. This system is commonly adopted by ethnic groups and features minimal management, but markedly low yield.

1.2.2 The commercial poly-culture system

This is the major system in terms of area covered and number of cultivars. The largest percentage of Vietnamese coffee growers operates under this system. The landownership system usually consists of small landholders growing coffee on small plots of less than 3 hectares in size (Ha and Shively, 2008). However, there are also several medium or large landholders with farms ranging from 4 to 6 hectares. The key characteristic of this system is the utilisation of different kinds of fruit and shade trees with the coffee plants. While the marketing of their coffee is the prime source of income for the growers, the fruit trees provide an additional, non-quantified source of income, and the fruit is also consumed on the farm by both people and domestic animals. The shade trees found in this system include durian (Durio zibethius), rambutan, mango, jackfruit and avocado trees.

1.2.3 The unshaded monoculture

This system has no tree cover at all and the coffee bushes are exposed to direct sunlight. This coffee producing system requires a high input of chemical fertilisers and pesticides plus the use of an intensive workforce throughout the yearly cycle. In Vietnam, the highest yields are obtained under this system.

The commercial poly-culture system is the major system with respect to numbers of coffee producers in Vietnam. As mentioned above, coffee is not only the prime source of income for the growers but the fruit production from shade trees used in coffee plantations can also provide a significant income for households, especially those with small and medium farms (less than three hectares). Therefore, diversification of the coffee production system would contribute to the economic security of the coffee growers which can be a crucial factor for coffee growing in Vietnam.

1.3 A complex system

Regardless of the nature of the coffee production system, all producers have to deal with complex issues in the modern business environment. The competitiveness of many products or services still depends on the quality and cost compared with the same products or services from other suppliers. Thus, many enterprises consider cost and quality as key factors that should be managed more effectively in order to improve the competitive advantages of companies. However, most of them only focus on intervention factors in the production system (e.g., the number of machines, up-to-date technology) to address the quality and cost of production issues. Indeed, in many cases, these factors may not be the root causes that can change the quality and cost of production. It is therefore clear that a more holistic approach is required to devise sustainable and long-term strategies to manage the complexities involved in reducing production costs and improving quality.

Systems thinking approaches have especially in recent years been widely applied in various scientific disciplines and fields such as planning and evaluation (Midgley, 2006), education (Frederiksen and Collins, 1989), business and management (Dutta, 2001), public health (Homer and Hirsch, 2006), sociology and psychology (Hirsch et al., 2007), cognitive science (Lewis, 2000), human development (Mildeová and Němcová, 2009), agriculture (Bawden et al., 1984), sustainability, environmental sciences (Petak, 1981),

ecology and biology, earth sciences (Sterman, 2002), and other physical sciences (Cabrera et al., 2008).

Systems thinking are the art and scientific methodology of making reliable inferences about the behaviour of a system under consideration by developing a deep understanding of its underlying structure (Richmond, 1994). It also consists of a set of principles and tools to deal with the complexity, ambiguity and mental models that underlie present social, economic, ecological, and political challenges (Bosch et al., 2007).

The supply and demand sectors and society all form part of a highly complex system. The application of a systems thinking approach is therefore essential for improving quality and reducing the cost of a production strategy. Traditional decision-making in a production strategy tends to involve linear cause and effect relationships. In contrast, a systems approach can help managers to understand the whole complex picture of bi-directional interrelationships between various elements and actors. This 'big' picture will provide more useful results than traditional methods. Moreover, systems thinking are generally recognised as a valuable aid to the strategic and tactical decision-making process during production (Wilson, 2004). Therefore, this approach helps to improve the understanding of and makes predictions about the performance of a production system.

There are not many applications of systems thinking available in the literature on coffee production, especially on the components which have a large effect on the cost and quality of coffee products. This paper therefore demonstrates how the application of 'quick fixes' fails to reduce the costs or improve the quality of coffee products. In the absence of a systems approach, managers may be working without a clear direction because they are mostly not aware of the 'bigger picture' they are operating in. Guidance for coffee production managers in systems thinking is provided to avoid the trap of short-term solutions.

The main aim of this study is to examine the effects of various factors, at the production stage, on the cost and quality of Vietnamese coffee. The study uses a system thinking approach and several systems tools to explore the inter-relationships between these factors. The resultant model of the Vietnamese coffee production would help to deepen the understanding of relevant stakeholders about cost reduction and quality improvement. It would also enable production managers to study the effect of a particular factor before implementing it in practice so that the best coffee production strategies can be identified.

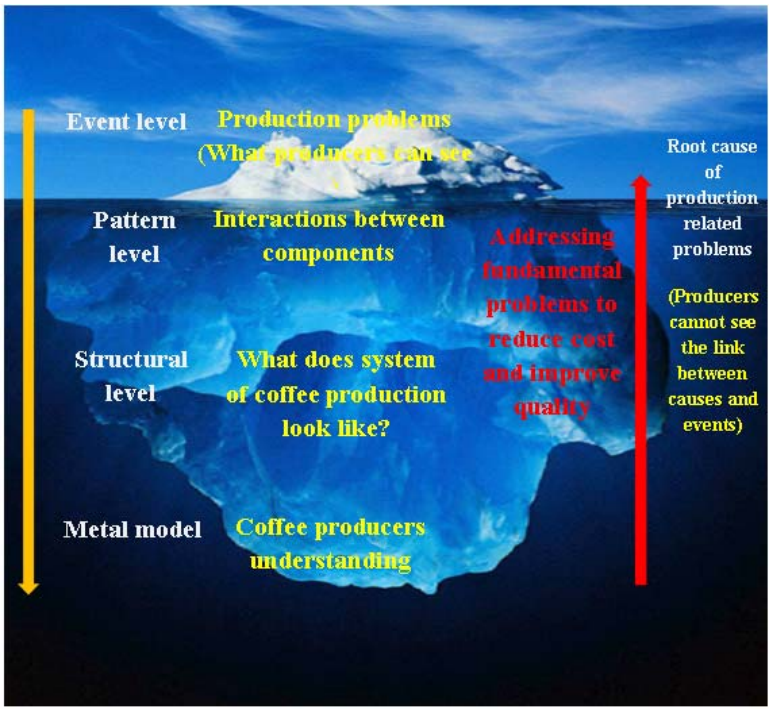
2 Methodology

2.1 Using a systems thinking approach

Systems thinking provides a 'new way of thinking' to understand and manage complex problems. It requires an understanding of the multiple relationships between various parts or segments of a system (Bosch et al., 2007). This approach is particularly relevant in addressing production management issues. It is important for production management because it provides an overseeing framework to help ensure that the same general requirements are addressed by management endeavours across organisations and with varying methodologies and tools. It would therefore not only have a high potential for application in coffee production, but could also be applied across other agricultural production contexts.

The analogy of an iceberg, as shown in Figure 2, is used as a metaphor for demonstrating the concept and philosophy of systems thinking. This image was simplified by Maani and Cavana (2007) and Bosch et al. (2013) to visualise the four levels of thinking. Managers can often only see the tip of the iceberg, i.e., the events which describe the symptoms of the reality, and the majority of decisions and interventions would normally take place at this level. This is due to the fact that events or symptoms are the most visible parts and often require immediate attention and action (Maani and Cavana, 2007). The next level is the pattern level, which shows how these events are related to a trend or pattern of behaviour. The third level of thinking is systemic structures which presents how patterns and segments of the system relate to and affect each other. Another deeper level of thinking located at the bottom of the iceberg and which hardly ever comes to the surface, is the perceptions, ideas, experiential knowledge and understandings of the people who are involved. "These are the mental models of individuals and organisations that influence why things work the way they do. Mental models reflect the beliefs, values and assumptions that we personally hold, and how they underlie our reasons for doing things the way we do" (Flood, 2010).

Figure 2 Four levels of thinking (see online version for colours)



Source: Adapted from Maani and Cavana (2007) and Bosch et al. (2013)

2.2 Developing a conceptual model of Vietnamese coffee production

An initial overall causal loop diagram (CLD) for coffee production has been developed. A CLD is a systems thinking tool which helps the stakeholders to conceptualise the real world for understanding the patterns of behaviour and interactions between all the

components (variables) of the system (Maani, 2013). In a CLD, the arrows indicate the direction of influence that connects the different variables (what affects a particular variable and what does this variable affect/cause), and 'S' and 'O' signs indicate the type of influence. The 'S' indicates that a pair of variables change in the same direction. An 'O' symbolises that change is taking place in an opposite direction. A conceptual model of Vietnamese coffee production was developed from information (variables) obtained in relevant literature and available documents as well as from consultations with coffee production experts. The variables were linked to each other through arrows indicating causes and effects of the different variables. The resultant CLD described the current coffee production situation in Vietnam (as was found through literature study and preliminary consultations with experts). The final CLD has been organised into three sub-CLDs, each representing a major theme, namely *Cost of coffee production, Coffee cherry quality* and *Coffee cultivation.*

2.3 Refining and validating the conceptual model

The area selected to refine the conceptual models consists of the central highlands provinces, also known as the 'Coffee Capital of Vietnam'. Data collection for this refinement and validation of the conceptual models was carried out through three workshops held between February and April 2014 plus a series of formal and informal meetings with professionals in the coffee industry. Key stakeholders who attended the workshops included farmers, managers, researchers, input suppliers (fertilisers, pesticides, herbicides, and seeds), traders and local government officials in the agricultural sector. These experts were selected on the basis of their extensive experience in the coffee industry. During the workshops, a list of issues, potential solutions, drivers and barriers was created from the perceptions and ideas of all the stakeholders (their different mental models). This list was evaluated, added to and refined during group discussions. The experts selected and defined an initial hierarchical structure of the primary drivers of change in the coffee production system, and, where their knowledge permitted, identified relationships (loops, feedbacks) between drivers in order to create the basis for the subsequent CLDs. The final CLD for coffee production in the central highlands of Vietnam was created after detailed discussions, agreement and acceptance of the models by all the stakeholders that were involved.

3 Results and discussions

3.1 Preliminary conceptual models of Vietnamese coffee production

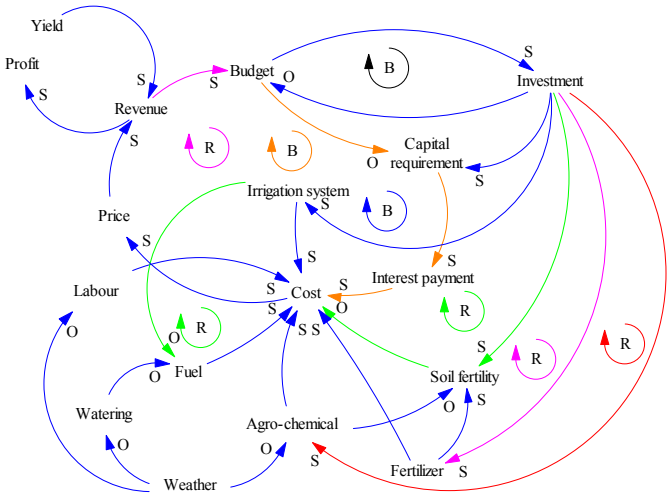
Three sub-CLDs were identified and are discussed briefly in the following paragraphs:

3.1.1 Coffee production cost

Figure 3 indicates that the cost of coffee production depends on different factors such as fertilisers, labour, irrigation systems, fuel, and agro-chemicals. If the cost of these sources changes, the cost of coffee production will also change. Changes in interest rates for bank loans also play a vital role in determining the cost of coffee production. Systemic

interventions that will reduce the costs of input factors and interest rates seem therefore essential to achieve a reduction in the costs of coffee production.

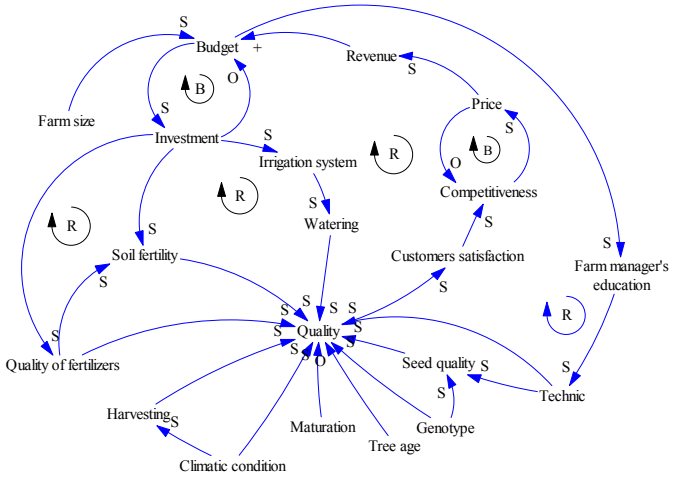
Figure 3 Inter-relationships between production cost and input factors (see online version for colours)



3.1.2 Coffee cherry quality causal loop

The quality of coffee cherries is usually the single largest contributor to the flavour and colour profile of coffee beans. However, the quality of coffee cherries is affected by many different factors including seed quality, climate conditions, and soil fertility. Therefore, if these factors are changed, the quality of the coffee cherries will also be changed (see Figure 4).

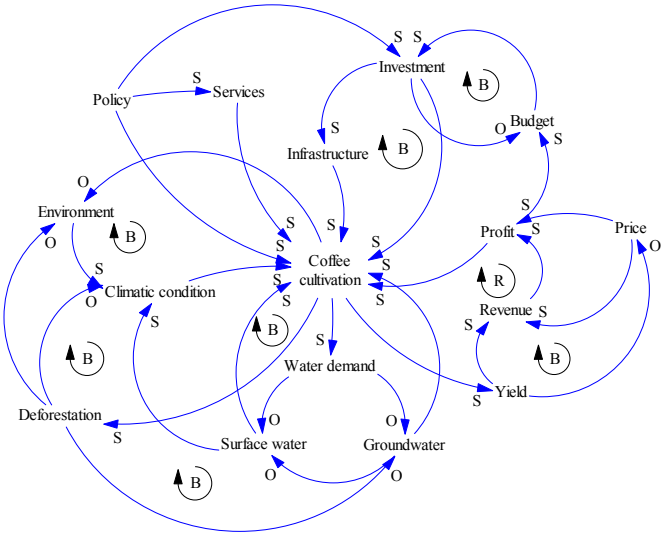
Figure 4 Relationships between a set of variables (or factors) influencing the quality of coffee cherries (see online version for colours)



3.1.3 Coffee cultivation

In Vietnam, coffee cultivation is affected by four key factors: climate conditions, policy, profit and yield. A change in any of these factors will lead to a change in coffee cultivation (see Figure 5).

Figure 5 Inter-relationships between coffee cultivation and the impact factors (see online version for colours)



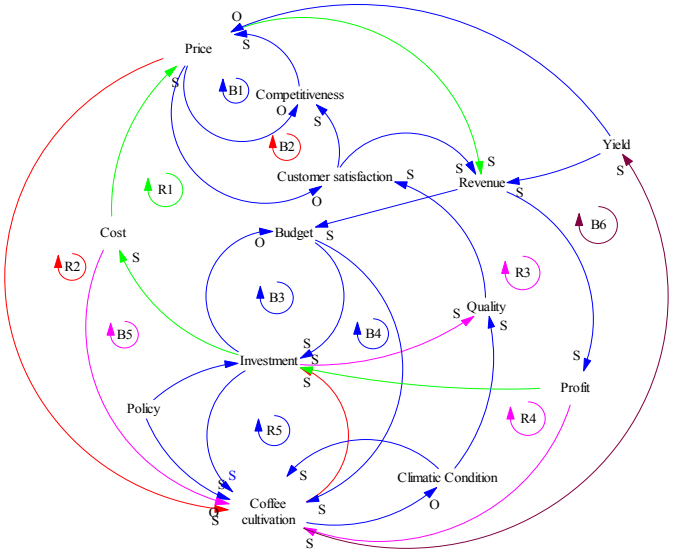
3.2 Combined conceptual CLD

In the past many researchers have studied the three sub-systems of coffee production (cost of coffee production, quality of coffee cherries and coffee cultivation) in isolation to describe the evolution of the coffee production system over time. The various factors in each of the sub-systems are actually highly interconnected and such studies could result in many incorrect interpretations and subsequently inefficient management strategies. The three sub-CLDs were therefore combined and interconnected to form one conceptual CLD (Figure 6).

Eleven loops are presented to form a CLD which shows the feedback mechanisms inherent in cost reduction and improving the quality of coffee cherries. These include five reinforcing loops (R1, R2, R3, R4 and R5) and six balancing loops (B1, B2, B3, B4, B5 and B6).

Figure 6 also shows that reduced coffee production costs would reinforce itself through the feedback chains (R1: *Cost – Price – Revenue – Profit – Investment*). When the cost of production decreases, it will lead to the price of coffee declining. If the reduced coffee price increases, however, revenue will decrease and profits will decline because of the decrease in revenue (Feuerstein, 2002).

Figure 6 Inter-relationships between cost, quality and cultivation area of Vietnamese coffee production (see online version for colours)



R2 (*Cost – Price – Coffee cultivation – Investment*) also indicates that a reduced coffee production cost would reinforce itself. It can be assumed that a lowering in the cost of coffee production will lead to reduced coffee prices. Therefore, coffee cultivation areas will also decline as a result of coffee price reduction. It means that the investment required for planting coffee, which is a major contribution to the cost of coffee production, should be reduced (Ha and Shively, 2008).

In the positive feedback loop R3 (*Quality of coffee cherries – Customer satisfaction – Revenue Profit – Investment*), the improved quality of the coffee cherries would reinforce itself through the positive chain. The assumption is that the improvement of coffee quality accelerates through investment strategies (fertilisers, improved technology, genotype, quality of seed, agro-chemistry and irrigation systems). When the quality of coffee improves, there will be more satisfied customers and the revenue that influences investment through increasing profits will be increased (Storbacka et al., 1994). In summary, increased investment will lead to coffee cherries with a higher quality.

Price affects both competitiveness and customer satisfaction. The negative feedback loop B1 (*Price – Competitiveness*) suggests that an increase in coffee price would cause a decline in the competitiveness of coffee. As a result the price of the product will decrease. In the negative feedback loop B2 (*Price – Customer satisfaction – Competitiveness)* the price is also one of the key determinants of customer satisfaction (Bregman, 1995). Therefore, it can be assumed that an increased coffee price will decrease customer satisfaction. This will lead to a decrease in the competitiveness of the product and as a consequence, the price of the product will also decrease.

B5 (*Cost – Coffee cultivation area – Investment*) illustrates that an increase in the cost of coffee production will tend to reduce the coffee cultivation area, which will lower investment in coffee production. As a result of this, the cost of coffee production will reduce. Thus the feedback loop connecting cost, coffee cultivation, and investment is a

balancing loop. Similarly, the feedback loop (B6) between coffee cultivation, yield and price is also a balancing loop.

3.4 Refined and validated final CLD of Vietnamese coffee production

3.4.1 Stakeholder mental models

In this section, the current issues and challenges that the coffee producers in Vietnam are facing are highlighted. Comprehensive descriptions of coffee production have been obtained from 63 participants (see Table 1) in eight stakeholder groups. Their participation in focus group discussions (G) or in-depth information interviews (K) are respectively indicated under interview mode as G or K.

Table 1 Stakeholders' participation in the interviews and group discussions

	Stakeholder groups	*No. of people involved*	*No. of interviews*	*Interview mode*
1	Farmers (producers)	20	8	G and K
2	Managers	4	4	K
3	Academics	4	4	K
4	Local authorities	4	4	K
5	Material suppliers	4	2	K
6	Traders	9	4	G and K
7	Transporters	6	2	G and K
8	Processors	12	6	G and K
	Total	*63*	*34*	

Table 2 Key variables of Vietnamese coffee production

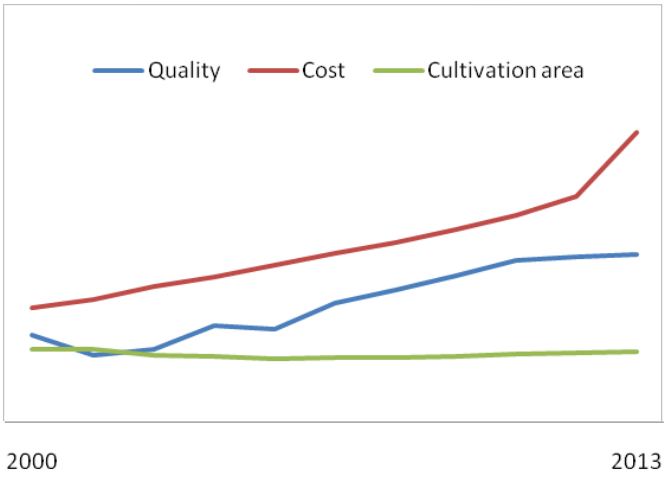
Coffee cultivation	*Cost*	*Quality of coffee berries*
Public service	Farm size	Seed quality
Infrastructure	Soil fertility	Maturation
Deforestation	Interest rate	Soil fertility
Price	Labour	Technological development
Profit	Irrigation system	Genetic type (type of coffee)
Budget	Weather	Climatic conditions
Ground water	Fertilisers	Quality of fertilizers
Surface water	Agro-chemical	Agro-chemical
Environment	Water	Harvesting
Climatic conditions	Fuel	Irrigation system
Agricultural policy		Watering
		Tree age
		Customer satisfaction

Source: Storbacka et al. (1994), Mohan and Love (2004), Leroy et al. (2006), Bitzer et al. (2008) and Eakin et al. (2009)

The key issues surrounding coffee production that were identified by workshop participants and interviewees are presented in Table 2. In the group discussions participants initially considered a range of potential events in coffee production without necessarily focusing on whether the potential implications are positive or negative.

Figure 7 indicates that the key events or variables (quality, cost, and cultivation area) in Vietnamese coffee production are continually changing over time. The overall directions of these key variables were determined from experiential knowledge and verified by both data and information that were obtained from in depth interviews with specialist coffee producers as well as managers in the central highlands of Vietnam. It is clear that both cost and quality of the coffee product have increased while the coffee cultivation area has not changed. The cost of coffee production increases gradually over time which can be explained by an increase in the price of input factors (fertilisers, pesticides, herbicides, labour cost, etc.) (Parrish et al., 2005). It is interesting to note that the quality of coffee cherries has been improving due to the fact that coffee producers are willing to invest more in technical training, quality of fertilisers, and agro-chemicals (Luong and Tauer, 2006). The coffee cultivation area remains constant at around 520,000 hectares. The main reasons for this are the influence of rural development policies on land cover, introduction of the protected forest areas policy and the strategy of exporting coffee that was produced in the central highlands (Muller and Zeller, 2002).

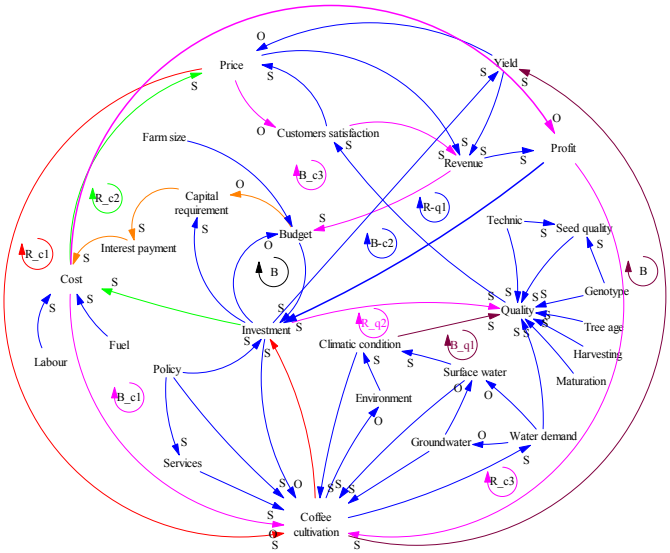
Figure 7 Behaviour over time of some key variables in the coffee production (see online version for colours)



3.4.2 Validation

Incorporation of new information gained from the workshops, interpretations and analysis of the conceptual model led to several refinements. These are discussed in the following paragraphs, which include the identification of various reinforcing and balancing loops in the final refined CLD (Figure 8).

Figure 8 The refined CLD for coffee production (see online version for colours)



Coffee production cost loops: There are three main reinforcing loops including R_c1, R_c2, and R_c3 and three balancing loops including B_c1, B_c2, and B_c3. These loops imply that when a company decides to reduce coffee production costs, it must reduce investment costs (infrastructure, fertilisers, irrigation systems, and fuel). The amount of fertilisers and fuel required, which occupies the majority of coffee production costs, has decreased significantly in recent years due to an increase in the cultivation level of the producers, together with the favourable weather conditions in the central highlands of Vietnam. When the cost of coffee production declines, the coffee selling price also decreases. As a result of a decreased selling price, producers have to reduce their coffee growing area to cut down investment. Therefore, the cost of coffee production will continue to decrease through less investment in coffee production (Loop R_c1). This loop is a vicious reinforcing feedback loop (*Cost – Price – Area – Investment – Cost*).

Loop R_c2 in Figure 8 was formed by the addition of two variables, revenue and profit (instead of the 'area' variable) in the feedback loop R_c1 (*Cost – Price – Revenue – Profit – Investment – Cost*). When coffee prices decline, the revenue from the coffee product will also decrease. The less revenue coffee producers generate, the less profit they receive. Reduced coffee profit requires producers to cut down investment, which will in turn decrease production costs.

The process of loop R_c3 in Figure 8 is similar to the feedback loop R_c2. The only difference lies in the addition of the variable 'area' which also directly impacts on investment. Similarly, less profit generation in coffee production will lead to a diminished cultivation area. Hence, investment in coffee production will reduce.

Reinforcing loops are not the only loops operating in the coffee production system. It is therefore essential to also focus on the other feedback loops to get a better understanding of how the whole system operates. Figure 8 illustrates three balancing loops of Vietnamese coffee production cost. In the negative feedback loop B_c1 (*Cost – Area – Investment – Cost*), a change of any variable, (for example, reducing the investment in coffee production), would eventually affect itself in a negative way. In

recent years, the price of input materials for coffee production has increased significantly and as a result the cost has also escalated. When the cost increases, coffee producers attempt to shrink their investment by cutting down those coffee growing areas which have a low yield. Subsequently, this effort will contribute to the reduction of the amount of materials used for production.

The reduction cost of coffee production loop B_c2 that connects cost, profit, and investment is similar to loop B_c1. It is assumed that a decrease in the cost of coffee production will lead to a rise in profit. When producers receive a higher profit, they are willing to invest more in input materials for their farms (e.g., fertilisers, agro-chemicals and seed). Consequently, the production cost will increase again.

The balancing loop B_c3 is different to both loops B_c1 and B_c2 (*Investment – Cost – Price – Customer satisfaction – Revenue – Profit –Investment*). When coffee producers cut down their investment in production, this will diminish the production cost. Subsequently, these efforts contribute to a reduction in the price of the coffee product which results in more customer satisfaction with the coffee product. An increase in the number of customers who are satisfied with the coffee product will lead to higher revenue for coffee producers and profits will increase. This will continue to attract bigger investments to expand coffee production. Consequently, the cost of production will increase again.

Improving quality: It can be assumed from Figure 8 that an increase in the quality of coffee cherries would reinforce itself through a positive chain as shown by reinforcing loop R_q1 (*Quality – Customer satisfaction – Revenue –Profit –Investment*). The customer (coffee processors, agents) will be more satisfied when the quality of coffee cherries improves which leads to coffee producers fetching higher revenue. Increased profit then results in raising revenue. The psychology behind Vietnamese coffee producers is still very much focussed on profit as the main reason for deciding whether or not to improve their investment in coffee production. Therefore, when producers obtain a higher profit in coffee production, they are willing to invest more in technology, quality of fertilisers, and agro-chemicals. This will in turn improve the quality of the coffee cherries.

The increasing quality loop R_q2 is quite similar to loop R_q1; this loop is formed by adding the variable of 'coffee area'. An increase in the profit of coffee production will motivate producers to expand their *coffee cultivation area*. This will result in more investment. When investment increases, it is expected that the quality of coffee cherries will also improve because an increase investment focuses on not only the quantity of input materials but also the quality of these materials. The quality loop R-q2 is thus also a reinforcing loop.

These reinforcing loops show the interrelationships between the quality of coffee cherries, customer satisfaction, profit, quality of investment, and coffee cultivation area. It explains how a change in one variable could lead to a change in the quality of coffee product.

The process of balancing loop B_q1 is similar to reinforcing loop R-q2. The only difference lies in the addition of the variable 'climatic condition' instead of 'investment' (Quality – Customer satisfaction – Revenue –Profit – Area – Climatic condition). When the coffee growing area is expanded, it will have some negative effects on the natural resources such as that the forest may be destroyed or the water resource may be over-exploited. As a result of these negative effects, the climatic condition will deteriorate. This is a main cause of the decline in the quality of coffee cherries.

In general, based on the conceptual models and their refinement and validation, it can be concluded that most loops are the same, in that investment plays an important role in both cost reduction and quality improvement of coffee. However, there are small differences between the conceptual and the refined models. One of the main differences is that while the conceptual model considers the relationship between competitiveness and profit that has a direct effect on investment in coffee production, the validation model does not address this factor. The main reason for this is that the coffee producers in Vietnam do not fully understand the term 'competitiveness'. Therefore, they only focus on the price of their coffee product in order to decide whether or not to invest in coffee production to improve quality and reduce production cost.

The CLDs provide an insight into understanding the dynamic interaction among the various components of the coffee production system. These diagrams can be used by coffee producers to obtain a general understanding of the relationships between the different factors that form a coffee production system in order to reduce cost and improve the quality of coffee cherries. Using CLDs would provide the analyst with a systems model of the overall effects of coffee production activities on cost and quality and also the influence of management decisions and other external factors impacting on the cost reduction and quality improvement process.

The development of a coffee production system model provides coffee producers with a snapshot of their farming system. This is an initial stage from which they can design their future decisions and strategies in order to reduce production cost and improve the quality of their coffee product with the aim to increase value-adding. The development of a coffee production system model would also provide firms with a better understanding of the inter-dependencies between quality, cost, cultivation area, investment, and policy systems as well as the management challenges associated with the implementation of reducing the cost and improving the quality of the coffee product. This model could also play a significant role in increasing the competitive advantages of the Vietnamese coffee product.

4 Conclusions

This paper discusses the use of a systems approach to address the challenging issues associated with coffee production in Vietnam and provides a series of supporting logics for the coffee producers. The CLDs play a vital role in depicting the feedback relationships underlying the major variables (e.g., investment in input materials, infrastructure) involved in reducing the production cost and increasing the quality of coffee products. The results of this study clearly indicate that the reduction of production cost and the improvement of coffee quality could be enhanced significantly through higher investment.

The contributions of this study are twofold. Firstly, the CLDs outlining the interconnected relationships between variables could assist research on reduced cost and increased quality of coffee products; they could also lead to a deepening of the coffee producers' understanding of the entire coffee production system. Secondly, the results of this study provide insights into the measures that could play a key role in improving the competitiveness of Vietnamese coffee.

As shown in the results of this study, the CLDs provide an initial basis for simulation modelling in which a variety of future scenarios for increasing coffee quality and reducing cost of production may be explored and leverage points could be more accurately identified. A systems thinking approach could be a potentially valuable tool for not only coffee production but also for other production sectors in terms of identifying how resource allocation within one area will affect other areas, as well as for reducing cost and increasing the quality of a product.

Further studies are being carried out to investigate the factors affecting cost reduction and quality improvement of coffee cherries by using simulated scenarios. In this way, the dominant feedback loops of the coffee production system will be identified more clearly and the necessary adjustments will be made for a more reliable coffee production system.

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CHAPTER 3

COFFEE PROCESSING MANAGEMENT TO INCREASE GREEN COFFEE QUALITY: A SYSTEMS THINKING APPROACH

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Coffee processing management to increase green coffee quality: a systems thinking approach

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Abstract: This paper investigates the advantages of using systems thinking in the analysis of coffee processing by developing an exploratory causal loop model. The causal loop model was established in workshops with participants who are experts in the coffee processing industry. This model is intended to equip managers with sufficient knowledge and understanding of strategic management in green coffee processing in order to increase the quality of their coffee beans. The causal loop model also allowed the identification of potential leverage points where systemic interventions will be most effective to increase the quality of green coffee beans.

Keywords: coffee processing; green coffee beans; green coffee quality; processing technology; modelling; systems thinking.

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1 Introduction

In today's competitive business world, suppliers are well aware of the importance of a high quality product in establishing and maintaining a global competitive position for their enterprises. They are aware that their customers are expecting high quality in both products and services. Customers have also become increasingly discerning and have started looking for options more in tune with their basic needs, requirements and hobbies (Sureshchandar et al., 2001). This requires the suppliers to continually improve the quality of their products and services to meet the demand of their customers and to stay ahead of the competition. During the past few years there has been a corresponding interest in research on quality management and different approaches to quality management have been undertaken to provide the solution to the aforesaid challenges by modern enterprises. One of the most attractive approaches and one that has received considerable attention is systems thinking. This is an integrated approach and results in long-term strategic thinking.

A systems thinking approach to the management of a quality product can impact on an organisation's ability to achieve its business objectives and to develop programs for increasing the competitive advantages of a company. Thus, this is an approach for continuously improving the quality of every aspect of the business process. This approach has been successfully applied in different aspects of quality management. Examples include' systems thinking in quality management' (Conti, 2010), 'a systems approach to service quality tools for hospitality leaders' (Testa and Sipe, 2006), 'a systemic approach to quality improvements: the interactions between the technical, human and quality systems' (Mandal et al., 1998), and' a framework for quality management research and an associated measurement instrument' (Flynn et al., 1994). In these studies, the researchers developed causal loop relationships among different variables. The resulting causal loop diagrams of their studies provide an insight into understanding the dynamic interactions. This helps to identify the implementation of proactive action, which is the philosophy of total quality management.

In the coffee industry, the management of the actual processing stage is very important because this stage determines the quality of the coffee product. The quality of green coffee is based on flavour and taste, as well as on the size, shape, colour, hardness of the coffee beans and the presence of defects (Feria-Morales, 2002), all of which mostly depend on the field being processed. 40% of the quality of the coffee beans is determined at post-harvest primary processing (Paulino De Moraes and Luchese, 2003). Therefore, it is important to understand that coffee processing has an effect not only on the quality of

the coffee beans but also on the long term competitiveness of these coffee products in the global market. This may also have an effect on the future growth prospects of the Vietnamese coffee market. Some research has been conducted on quality management in both coffee producing and coffee consuming countries. However, there is relatively little information available on the management of coffee quality during the green coffee processing stage. In particular, hardly any information exists on increasing the quality of coffee beans by using a systems thinking approach as a tool for the management of the coffee processing stage.

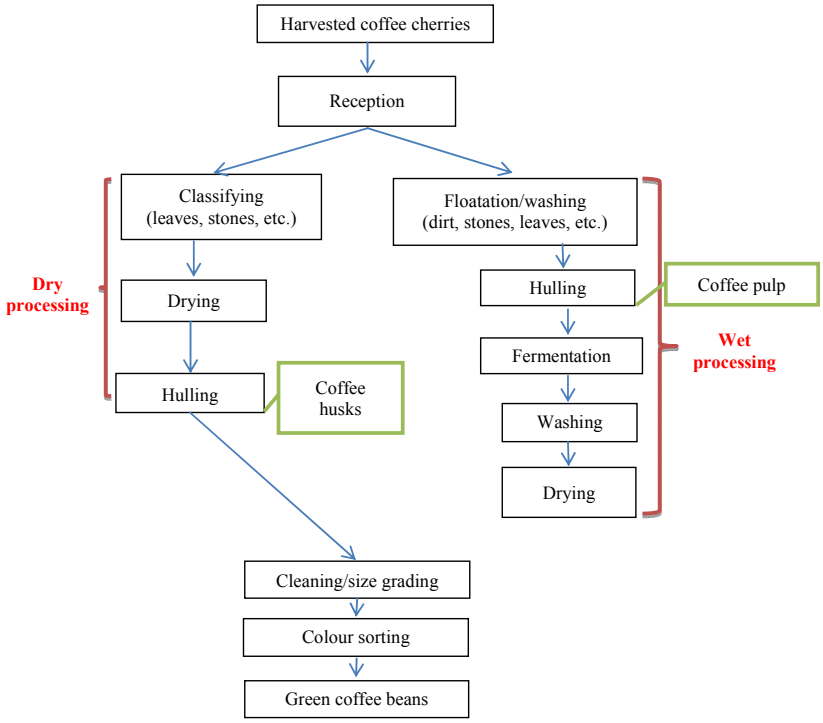
In this exploratory study, a systems thinking approach is used as a 'new type' of management for the primary processing of coffee in Vietnam to increase the quality of green coffee beans. Causal loop modelling is applied in conceptualising a quality management model of the primary processing of coffee beans which describes the relationships and influences between quality improvement actions and related factors in coffee bean processing.

2 Background of primary coffee processing in Vietnam

The processing of coffee is initiated with the conversion of coffee cherries into green coffee beans, this is called primary processing. Primary coffee processing is carried out within coffee plantations. In Vietnam, coffee beans are processed in one of two major ways (see Figure 1); dry processing (traditional method) and wet processing (modern method). It involves harvesting the coffee cherries and drying them to reduce the moisture content from 25%–60% to 10%–15% (Duarte et al., 2005). In the industrial agricultural processing sector of Vietnam, coffee processing is a major manufacturing industry, seeking value added profits for the processors.

Dry processing: This method is technologically simple compared to wet processing; it is also convenient and more often used in households where there is insufficient financing to invest in advanced technological equipment. The dry method is generally used with Robusta coffee, however, in Vietnam it is used for most of the Arabica coffee processing. With the dry processing method, the coffee cherries are picked and laid out to dry, either in the sun for two to four weeks (natural) or in the kiln (artificial method). The purpose of this is to loosen the inner green bean from its husk. The outer skin and pulp are then stripped away by hulling machines and the green beans are left. Vietnam is located in a tropical region, thus natural or sun-drying is the method commonly employed on small farms and in households. This method has the advantage of not requiring any equipment investment or energy costs. However, it requires large drying areas (usually concrete surfaces). The process is slow, ranging from two to four weeks, with the berries usually spread out in a thin layer in order to avoid fermentation. Frequent raking is also required to avoid mould proliferation and to provide homogeneous drying conditions. Artificial drying can be employed either as a substitute or to complement natural drying. Several types of equipment are used, including static, rotary, horizontal and vertical dryers, and the process can be continuous or in batches (Copeland, 2010).

Figure 1 Flowsheet illustrating the primary processing of coffee (see online version for colours)



Source: Adapted from Copeland (2010)

Wet method: This is the second type of primary processing and is generally used for Arabica coffee. This method does not require the drying of the cherries themselves. First, the coffee cherries are fed into a pulping machine that removes the soft outer layer, leaving the green beans and the sticky covering. The beans are then put in tanks of water to soak for 6 to72 hours. During this time the sticky covering ferments, allowing it to be removed by repeated washing. Finally, the green beans are dried, cleaned, and sorted as in the dry method.

Applying the wet processing method produces a higher quality of coffee beans. However, this method requires strict sorting of the fruit prior to processing since this treatment involves a mechanical step which can only be executed on fully ripe coffee cherries. In contrast, the dry coffee processing method can be applied to both unripe and overripe fruits, since this approach involves merely the simple drying and hulling of the coffee fruits.

In general, coffee processing in Vietnam is not yet well developed and is limited to simple processing through the application of traditional methods. Most green coffee beans are processed by using the dry method and there are only a few coffee processors in the central highland of Vietnam who apply the wet processing method to produce coffee beans. The export price is therefore lower than that of other countries such as Brazil and Columbia. For export purposes Vietnam needs to increase the volume of coffee that is produced through the wet processing method. This can be done through investment in wet coffee processing facilities which will enable Vietnam to not only export coffee at a much higher price, but also increase its global competitive position.

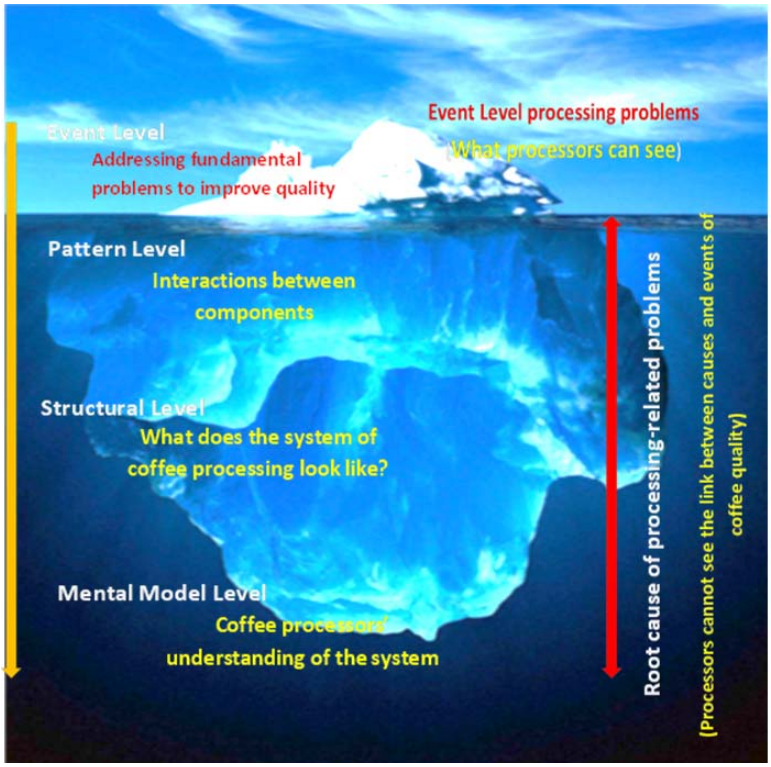
2.1 Systems thinking approach

Systems thinking and system dynamics, as proposed by Maani and Cavana (2007), were selected as appropriate approaches to deal with the complexity of the issue under consideration. The systems thinking approach is particularly useful in complex situations where data are limited. System dynamics was developed by Jay W. Forrester in the early 1960s as a practical application of feedback control concepts to various kinds of systems. While system dynamics helps to describe how a system is interconnected with feedback loops that create the nonlinear behaviour so frequently associated with modern day problems (Forrester, 1993), a basic premise of systems thinking is that systems produce the results that they are designed (either intentionally or by default) to produce. In systems thinking, the systems that characterise organisations can be influenced (via interventions) or even altered (via redesign) to more effectively produce the desired results (Barthelemy et al., 1998). Systems thinking provides a 'new way of thinking' to understand and manage complex problems. It provides ways to understand the multiple relationships between various parts or segments of a system (Bosch et al., 2013). Therefore, the application of this approach has been widely and successfully applied in different fields and disciplines, such as medicine (Leischow and Milstein, 2006; Waring, 2007) and engineering (Sage and Cuppan, 2001) to psychology (Schwartz, 1990), from economics (Jackson, 2009) and business management (Van Ackere et al., 1993; Rubenstein-Montano et al., 2001) to art (Root-Bernstein, 1985) and many others. This approach is particularly relevant for showing the power of processing management when placed in a systems context. It is important for processing management because it provides a holistic framework to help ensure that the same general requirements are addressed by management endeavours across organisations and with varying methodologies and tools. It would thus not only have a high potential for application in coffee processing, but could also be applied across other agricultural products processing contexts.

As a starting point for understanding systems thinking, the image of an iceberg was used as a metaphor for an organisation (Figure 2). This image was simplified by Maani and Cavana (2007) and Bosch et al. (2013) to visualise four levels of thinking. Managers can see the tip of the iceberg, that is, the events which describe symptoms of reality, and the most decisions and interventions take place at this 'Event Level'. This is due to the fact that events or symptoms are the most visible part and often require immediate attention and action (Maani and Cavana, 2007). The systems thinking approach suggests that intervention should be made at root cause level. This level of awareness is termed the 'Pattern Level', in which these events are related to the trends or patterns of behaviour in the system as a whole. The next level of thinking is 'Systemic Structures', which presents how the patterns and segments of the system relate to and affect each other. A deeper level of thinking is at the bottom of the iceberg and hardly ever comes to the surface. This level consists of the 'Mental Models' or perceptions that people have about the issue under consideration – 'a mental model of individuals and organisations that influence why things work the way they do. Mental models reflect the beliefs, values and assumptions that we personally hold, and how they underlie our reasons for doing things the way we do (Maani and Cavana, 2007). They are conceptual representations of the structures of external systems used by people to describe, explain and predict the behaviour of a system (Johnson-Laird, 1983). According to Vázquez et al. (1996), mental models are usually expressed by a set of sentences in ordinary language, describing both

the interactions among elements within the system and their external influences. Mental models are extremely simple compared to real data, also not fixed and contain rich information (Meadows et al., 1992).

Figure 2 Four levels of thinking (see online version for colours)



Source: Adapted from Bosch et al. (2013) and Maani and Cavana (2007)

2.2 Systems thinking application in primary coffee processing

The modelling of coffee processing in this section focuses on investigating the quality of a coffee bean product in Vietnam. The target is to define the elements affecting the standard of the product. There is no doubt that the system involves many elements which are highly interconnected. In this study the way in which these elements are related to each other and how these interrelationships affect the quality of the coffee bean product, is explored.

The study commenced with the *identification of the coffee processing variables*. Around 20 representatives of coffee processors from different companies and farms, as well as a number of experts in the coffee industry in the central highlands of Vietnam were invited to engage in this study to identify the current issues and challenges that they are facing.

The discussions of participants were also used to *identify structural elements* that were related to the processing stage. The variables were grouped into three categories –

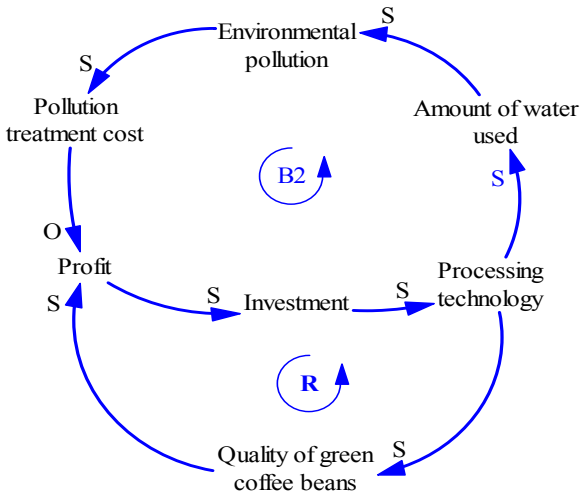
those that affect the quality of coffee bean (including the quality of cherries, technology and quality control).

The key variables and other significant aspects of the discussions were combined into simplified scenarios. These scenarios were subsequently analysed to identify causal links between the key variables and causal loop diagrams were created.

2.3 Creating a causal loop diagram (CLD) of the coffee processing system

A CLD is a system thinking tool which helps modellers to conceptualise a real world system in terms of feedback loops. Causal loop diagrams have been applied in various areas such as production, inventory management, quality management and manpower planning, research and development management, corporate planning and quality management (Mandal et al., 1998; Sureshchandar et al., 2001; Moon and Kim, 2005; Cabrera et al., 2008; Conti, 2010). It provides a framework for understanding the patterns of behaviour and interactions between components. In a causal loop diagram, the arrows indicate the direction of influence that connects different types of variables, and 'S'/'O' signs are used to indicate the type of influence. The 'S' sign indicates that the variables change in the same direction while the 'O' sign symbolises that change is taking place in an opposite direction.

Figure 3 Reinforcing loop and balancing loop of coffee processing (see online version for colours)



In this study a causal loop diagram for coffee processing quality management was created after detailed discussions between the workshop participants. A step by step description is provided in the following section. Some of the ideas from these experts and academics were straightforward, while others were more disturbing. They are visualised in Figure 3. The main conclusion of the workshops was that all the enterprises seemed to be caught up in both a reinforcing loop (increasing green bean quality) and a balancing loop (environmental pollution) in order to improve coffee processing technology.

2.4 Quality of coffee cherries in processing

A reinforcing loop indicates that if the quality of coffee cherries is high then three key factors (size and shape of beans, colour of beans, and black/broken beans) determine the quality of the green beans (Figures 4a and 4b). The right size, shape and colour lead to an improvement in the quality of the green beans. The percentage of black and broken beans declines as the quality of coffee cherries improves. Profits of the processors increase as a result of improved quality of green beans. This clearly proves that any investment to improve coffee production will contribute to better quality coffee cherries and consequently green coffee beans. An increase in the level of customers satisfied with the quality of the green coffee beans will lead to a higher profit. Consequently, the quality of coffee cherries will escalate by increasing the investment for coffee production.

Figure 4a Reinforcing loop showing effects of improved quality coffee cherries (see online version for colours)

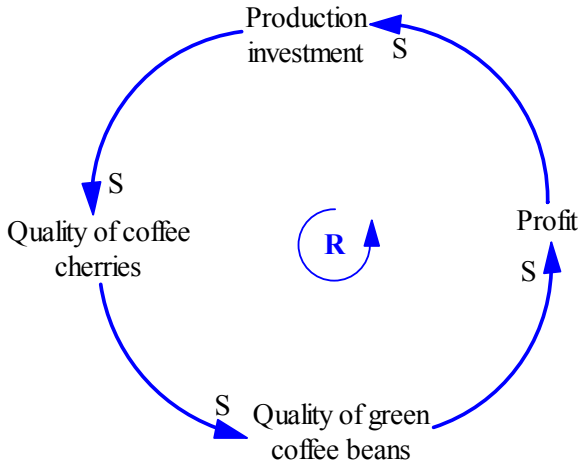
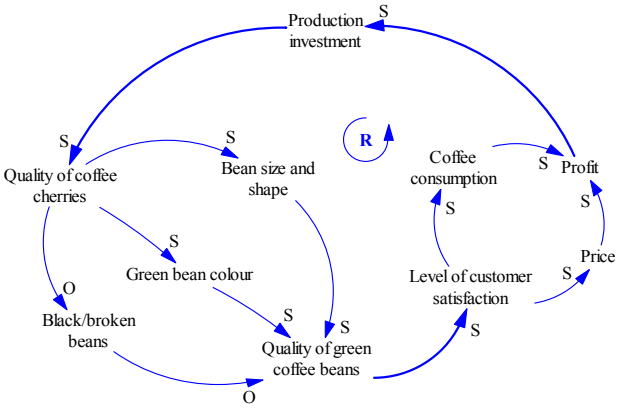


Figure 4b CLD of the quality of coffee cherries (see online version for colours)



2.5 Technology in coffee processing

The postharvest processing method is important for enhancing the quality of the aroma and flavour of coffee. At the primary coffee processing level, technology is the most important factor for maintaining quality. Thus, if an enterprise increases investment in processing technology, then the duration of the coffee processing (washing, drying, cleaning/size grading, and colouring) will be shorter (Figure 5a). As a result, the colour and flavour of the coffee beans will improve. Consequently the customers (coffee exporters and coffee roasters) will be more satisfied. This is the main stimulant that will lead to both processors fetching a high price and an increase in coffee consumption. An increase in profits then either raises the price or consumption. The high profits of coffee processing will have a positive impact on the quality of the coffee beans as processors will be willing to invest more in technology such as drying, washing, sorting and polishing machines. When an enterprise invests more in coffee processing technology, the productivity of processing will increase. As a result, the cost of processing will decline. Consequently the profit of coffee processing company will increase (Figure 5b).

The coffee processing method used is usually the single largest contributor to the flavour and colour profile of coffee beans. There are two main types of coffee processing in Vietnam. The dry process, known as the natural method, produces coffee that is heavy in body, sweet, smooth, and complex. The wet process is the second type of processing; this technique of processing ensures a much higher quality product. It requires processing equipment (for the initial cleaning classification-pulping-fermentation-washing and drying), an abundant supply of clean water, and the harvesting of ripe fruits only. If the processing technology is improved, the quality of the coffee beans also increases (see Figure 6).

Figure 5a The processing technology and green coffee beans loop (see online version for colours)

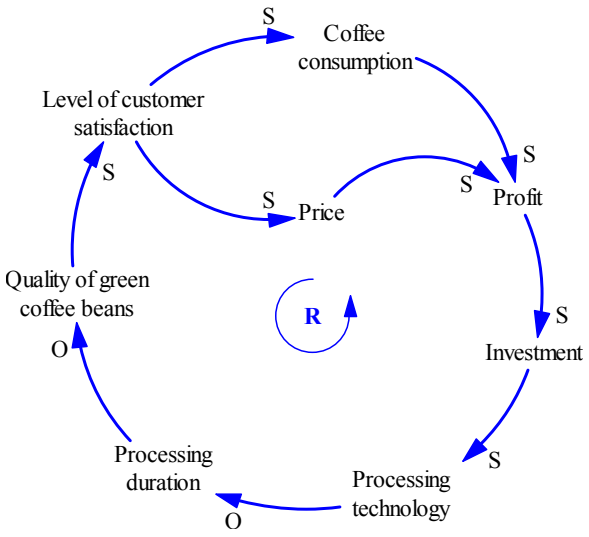


Figure 5b Reinforcing loop of coffee processing technology (see online version for colours)

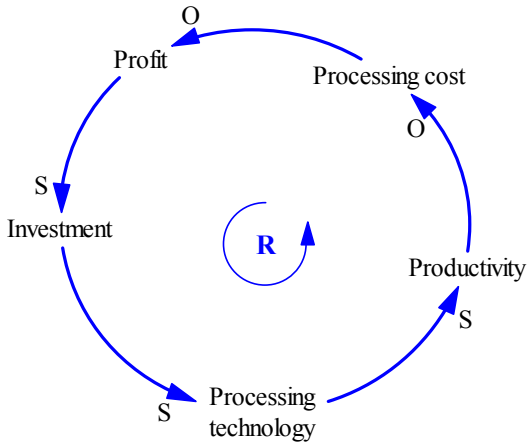
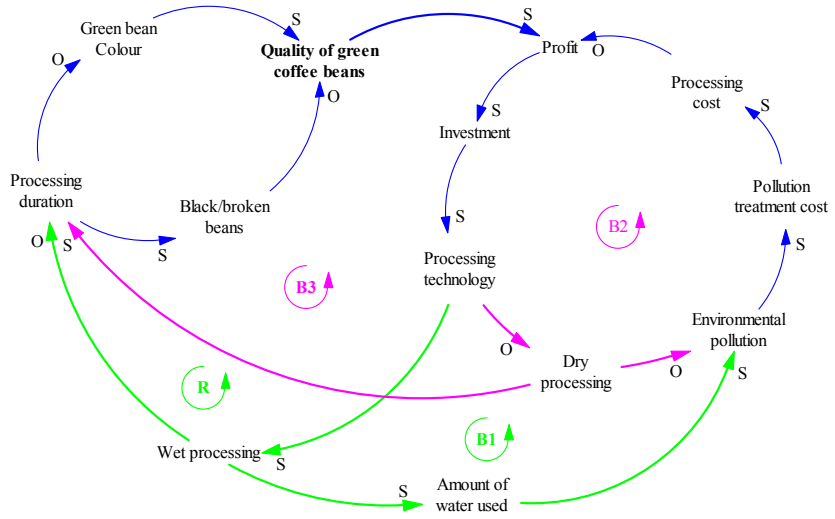


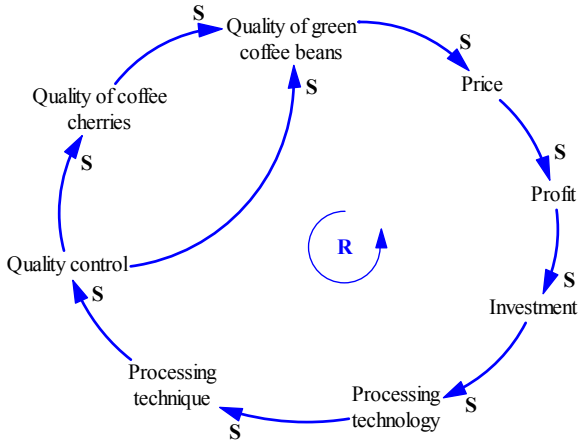
Figure 6 Effects of different types of coffee processing technology (see online version for colours)



2.5 Quality control (management) in processing

Quality control in coffee processing plays a pivotal role in improving the quality of green coffee beans (Figure 7). Thus, if an enterprise invests more in coffee processing technology, then the techniques required for this type of processing are more complicated. As a result, more effort from the managers is required during this stage of the process. This intense focus by managers will have a positive impact on the quality of coffee beans because managers then have to be stricter in not only operating the equipment, but also controlling the input material for processing through managing appropriate planting density, pruning and harvesting time of the coffee cherries. These are key factors for improving the quality of green coffee beans.

Figure 7 Quality control in coffee processing (see online version for colours)



According to Maani and Cavana (2007), a causal loop is a conceptual tool that reveals relationships amongst a set of variables or factors. Figure 8 shows the thirteen different loops that form the CLD. This reveals the feedback mechanisms inherent in the processing technology and improving the quality of green coffee beans during processing. These feedback loops show ten reinforcing (R1 to R10) and three balancing loops (B1, B2, and B3). In the following paragraphs the key causal loops in the coffee processing system are discussed.

Figure 8 illustrates that coffee processing technology costs would be reinforced through the feedback chains in both dry processing technology (R1) and wet processing technology (R4). If coffee processing enterprises decide to increase their investment in processing technology, more investment will be made in wet processing. This means that bigger quantities of the coffee cherries will be processed through wet processing. By doing this, the duration of the processing stage will be reduced, leading to an increase in the quality of coffee beans. When this occurs, the level of customer satisfaction (coffee roasters or coffee exporters who consume green coffee beans) will also be higher. The profits will be increased through an increase in either coffee price or coffee consumption.

Enterprises continue to use profits to increase investment for processing technology. However, increases in investment in processing technology also create unexpected results (B1). When coffee enterprises increase their investment in wet coffee processing technology, environmental pollution escalates through an increase in the amount of water used for washing the parchment. Washing the parchment after completing fermentation, leads to the consumption of a large amount of water that becomes highly contaminated and difficult to treat. Consequently, a reduction of profits accelerates through an increase in the pollution treatment costs which are a part of the processing payment. This leads to a decline in the investment in processing technology.

Loop R6 (Figure 8) shows that an increase in production investment (such as seeds, fertilisers, technique, irrigation systems etc.) will result in upgrading coffee cherry quality, which in turn will increase the quality of green coffee beans via reducing the black/broken beans and having the right size, shape, and colour. The coffee enterprises will receive higher prices and get higher profit as a consequence of higher green coffee

bean quality. An increase in profit in turn will increase the investment ability of coffee production enterprises.

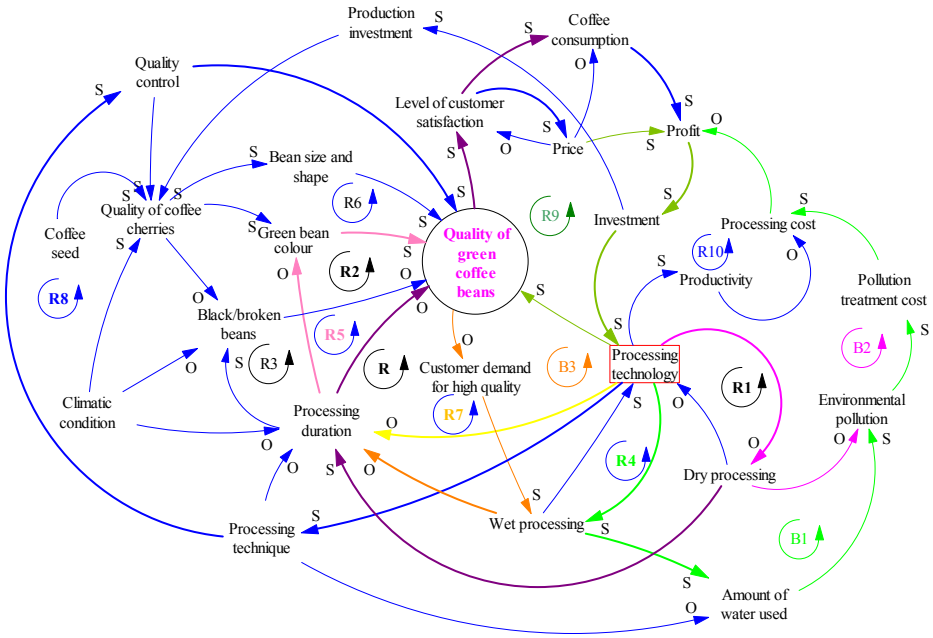
In the positive feedback loop R8, the improvement of processing technology would reinforce itself through the quality control chain. If the improvement of processing quality accelerates through investment, the requirement for improved processing techniques will be higher. This means that the processing chain will be more closely supervised by managers and consequently, the quality of the green beans will improve. An increase in the number of customers satisfied with the quality of the green coffee beans will lead to a higher profit. Consequently, the investment in technology for coffee processing will increase.

3 Conclusions

This study analyses the issues related to the quality of green coffee beans from a coffee processing system perspective. Major elements and cause-effect relations in the coffee processing system have been identified. The influence diagram (Figure 8) is a high-level model that can be used by managers to obtain a general understanding of the relationships between the different factors that form the coffee processing system. Using this particular systems thinking approach could provide managers with a model for the overall dynamics of the processing system in terms of quality, profits, level of customer satisfaction, management decision making process and other external factors. Details of the effects and causes of each factor could provide managers with the ability to develop an understanding of all the elements that are involved in the processing system and the influences they exert.

A number of researchers who have conducted studies of coffee processing have offered frameworks through which coffee enterprises can assess their coffee processing technology to increase the quality of green coffee beans (Muschler, 2001; Feria-Morales, 2002; Bytof et al., 2005; Duarte et al., 2005). However, these studies provide coffee processing managers with only a snapshot of their enterprises. Such frameworks are not effective tools for coffee processing managers because they do not identify the root causes that enhance coffee quality in the processing stage. They do not demonstrate the impact of the changes in the different elements of the system as a whole. In contrast, the causal loop of this study (see Figure 8) illustrates all the factors required to increase the quality of green coffee beans. The completed loops between different elements, which impact directly on the quality of coffee beans in the coffee processing stage, are explained in detail. This provides coffee processing managers with the ability to develop effective long-term strategies for increasing the quality of their green coffee beans. In addition, these completed causal loops in this study can effectively help managers towards implementation and assessment of successful coffee processing management initiatives and assess their dynamic impact on the quality of coffee beans because it focuses on all the mechanistic feedback loops and considers humanistic issues of relational and emotional intelligence as secondary. Therefore, the systems thinking and system dynamics approaches used in this study would constitute an extension and application of the management science tools derived from the work of Frederick Winslow Taylor (Taylor, 1947, 1964).

Figure 8 CLD of the coffee processing system (see online version for colours)



The systems thinking approach provides valuable insights into the coffee processing stage. It helps to select the important factors and their interactions that have the greatest potential to increase the quality of coffee beans. This study shows that the causal loop diagrams enable managers to see beyond current reductionist approaches to develop suitable strategies for the development of coffee processing. The causal loop diagram of the major elements in coffee processing expands managers' understanding of the important role of

1 the quality of coffee cherries

2 the processing technology

3 the quality control in producing quality green coffee beans.

The key factor in increasing the quality of coffee cherries lies in the production stage. Interventions therefore can be focused on improved investment in this stage via seeds and input materials. For the processing technology, the key factor that contributes to increasing the quality of coffee beans is the application of wet processing technology. However, there is a potential difficulty with this solution because the upgrade of wet processing technology would require huge investments (for buying the technology and also for solving the resulting environmental pollution problems). This is especially difficult for small and medium coffee enterprises, which form the majority of the enterprises in Vietnam. Interventions for this scenario should be focused on investment in wet processing technology which is produced domestically and uses less amounts of water. The cost of investment and environmental conflicts in this case could be resolved in this way. With regard to the quality of management, the major factor is strictly managing the operating equipment, as well as controlling the input material for

processing. Training/skill development of managers is the primary intervention to achieve this.

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CHAPTER 4

APPLYING A SYSTEMS THINKING APPROACH TO ADDRESS THE BARRIERS AFFECTING THE VIETNAMESE COFFEE EXPORT INDUSTRY

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Contribution to the Paper	Designed and performed the survey, data analysis and interpretation, wrote manuscript, and acted as corresponding author		
Overall percentage (%)	80		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	8/2/2017

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

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APPLYING A SYSTEMS THINKING APPROACH TO ADDRESS THE BARRIERS AFFECTING THE VIETNAMESE COFFEE EXPORT INDUSTRY

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ABSTRACT: *A systems thinking approach is used to identify and analyse the export barriers that the Vietnamese coffee export enterprises are facing in the international markets. Several causal loop diagrams were developed to provide a better understanding of the barriers. Models of general internal and external barriers to the export of coffee were developed to obtain an understanding of the complex relationships between these barriers and how they affect Vietnamese export in the international markets. Various strategies are proposed to reduce the impact of the barriers on coffee export activities.*

KEYWORDS*:* Export barriers, Vietnamese coffee, systems thinking, and causal loop diagram.

INTRODUCTION

Export activity has traditionally become a core component of national importance; and the determinants of the export performance of enterprises are of great interest for policymakers, export company managers and also researchers (Katsikeas *et al.*, 1996; Lages and Montgomery, 2004; Sousa *et al.*, 2008). This is because engagement in export operations is vital for a number of reasons, e.g. spreading business risks across different markets and ventures (Harrigan, 1988); providing a better profit base to attract and reward shareholders and employees (Greene *et al.*, 1994); generating more revenue as well as funds for reinvestment and also further growth (D'costa, 2002).

Coffee is one of the most traded commodities in the world (Lewin *et al.*, 2004). In Vietnam, coffee is now one of the vital agricultural export products of the Vietnamese economy. It ranks second in earning export value for the nation (after oil). Vietnam's coffee export has been estimated at 1.6 million tons, a turnover of more than $3 billion, which makes Vietnam one of the world leaders in exporting coffee, second only after Brazil (Ha and Shively, 2008). However, despite the many benefits deriving from exporting coffee, the entry into overseas markets for Vietnamese coffee enterprises remains difficult. Vietnamese coffee firms/enterprises are confronted by many serious problems, the most common problem being limited organizational and managerial resources (Sharma, 2000); an inappropriate foreign marketing strategy; restrictive international trade rules and regulations; different business practices and unfamiliarity with the habits of overseas customers (Bilkey and Tesar, 1977); differences between domestic and foreign task environments; and excessive risks and costs due to large geographic and psychological distances (Leonidou, 2000). These difficulties limit the coffee companies' potential to exploit foreign market opportunities, weaken their financial

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performance, delay progression along the internationalisation path, or even cause complete withdrawal from overseas operations (Dichtl *et al.*, 1984). Therefore, understanding the export problems has become essential for coffee export managers. They need to be able to proactively take suitable measures to overcome or reduce the impact of these problems, especially in the case of 'controllable' barriers.

In response to the aforementioned problems, numerous studies have been conducted to investigate the effect of exporting barriers across industries (Leonidou, 1995; Campbell, 1996; Ramaseshan and Soutar, 1996; Milner *et al.*, 2000; Leonidou, 2004; Yannopoulos and Kefalaki, 2010). However, only a few studies have investigated the effects of several types of exporting barriers to a specific product, such as steel, paper, wine, or logistics services (Bauerschmidt *et al.*, 1985; Nogues *et al.*, 1986; Henson and Loader, 2001; Ravi and Shankar, 2005). The focus on one specific product is expected to provide a more accurate assessment of the role of exporting barriers, because the research context in this case is more homogeneous than doing an investigation across industries (Leonidou, 2004). This article therefore aims to contribute to the diversified literature on the effects of exporting barriers by offering a comprehensive and insightful analysis of all the barriers affecting the export of one specific commodity, namely coffee. This was done by combining the effects of the two important kinds of common export barriers:

- **internal barriers** (*price, product, distribution and logistics*) and
- **external barriers** (*governmental, task and environmental*)

to the export performance of the Vietnamese coffee industry.

THE NATURE OF COFFEE EXPORT BARRIERS

Vietnam's coffee industry is expected to show strong growth during the coming years, thus increased export activity is an important factor that is expected to fuel the industry's growth. However, over recent years the export of Vietnamese coffee has encountered a large number of barriers that can be classified in two main categories: **internal**, which consists of barriers associated with organisational resources/capabilities and company approaches to export and **external**, which includes the barriers stemming from the home and host environment within which the firm operates (Leonidou, 2000).

Internal barriers such as price, quality of the product, distribution, logistics and promotion exert a major influence on export activities that deal essentially with a company's *coffee products* (e.g. developing new coffee products for niche foreign markets, adapting export product design/style to meet quality specifications, export packaging and labelling requirements), *pricing* (offering a satisfactory coffee price to foreign customers, matching that of competitors), *distribution (*complex foreign distribution channels, accessing export distribution channels), *logistics* (supplying an inventory to overseas markets, unavailability of foreign warehouse facilities), and *promotional activities abroad* (adjusting export promotional activities) (Henson and Loader, 2001; Leonidou, 2004).

External barriers refer to problems in identifying *governmental barriers* (pertaining to action or inaction by the home government in relation to its indigenous exporters), *task barriers* (focussing on the firm's customers and competitors in foreign coffee markets) and *environmental barriers* (referring primarily to the economic, political/legal, and sociocultural

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environment of the foreign markets within which a company operates) (Morgan and Katsikeas, 1997; Leonidou, 2004).

SYSTEMS THINKING AS A METHODOLOGY

Systems thinking is a set of knowledge, tools and principles which provides a "new way of thinking" to understand and manage complex problems. It helps to recognise the wider connections and how various parts or segments of a system influence each other (Bosch *et al.*, 2007) and is considered as one of the core disciplines for building an effective learning organisation (Senge, 2006). Systems thinking has been developed and applied extensively in various contexts and fields such as evaluation (Midgley, 2006), education (Frederiksen and Collins, 1989), business management (Van Ackere *et al.*, 1993; Rubenstein-Montano *et al.*, 2001), medicine (Leischow and Milstein, 2006; Waring, 2007), engineering (Sage and Cuppan, 2001), psychology (Schwartz, 1990), economics (Forrester, 1993; Martin and Sunley, 2007), art (Root-Bernstein, 1985) and many others.

The systems thinking approach is particularly relevant in addressing exporting management issues to help analyse and explain the complexity that arises through the effects of barriers on export activities. Systems thinking provides the ability to see the export situation and the interacting relationships more holistically. It would therefore not only have a high potential for application to the export of coffee, but could also be applied across other exporting contexts. In this paper, a systems thinking approach is applied to capture the interactions of coffee exporting barriers and analyse their impact on the coffee export activities of Vietnam.

The study was conducted with 40 representatives of coffee exporters working for different companies and 20 experts in the central highland of Vietnam. The participants were invited to engage in this study to (1) consolidate existing knowledge of the nature of barriers and their association with coffee exporting; (2) use causal loop diagrams to analyse the characteristics, content, and impact of each barrier on export-management decisions in coffee firms; and (3) to recommend strategies for managing coffee export barriers.

A number of workshops were organised in the central highland of Vietnam. During these workshops, a list of the export barriers was defined by individuals who are familiar with the actual Vietnamese coffee export situation. International business literature was also studied to add to the experiential knowledge of the participants. Workshop attendees were asked to review the information on barriers from literature beforehand and these were then added to the list. Based on this list of barriers, causal loop diagrams (CLDs) were constructed to explore the correlations among coffee export barriers. *"A CLD is a systems thinking tool which helps modellers to conceptualise a real world system in terms of feedback loops. It has been applied in various areas such as production, inventory management, quality management and manpower planning, research and development management, corporate planning and quality management. It also provides a framework for understanding the patterns of behaviour and interactions between components. In a causal loop diagram, the arrows indicate the direction of influence that connects different types of variables, and 'S'/ 'O' signs are used to indicate the type of influence. The 'S' sign indicates that the variables change in the same direction while the 'O' sign symbolizes that change is taking place in an opposite direction"* (Van Ackere et al., 1993; Storbacka *et al.*, 1994; Mandal *et al.*, 1998; Rubenstein-Montano et al., 2001; Moon and Kim, 2005; Testa and Sipe, 2006; Cabrera *et al.*, 2008; Winz *et al.*, 2009). The CLDs

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in this study are categorised into two groups (*internal and external barriers*) which will be separately analysed in the following section.

RESULTS AND DISCUSSION

An analysis of the internal barriers

Internal barriers are the most important problems for coffee export.

- ***Product***

Managers of coffee enterprises consider the product barrier as the most important among the internal barriers that influence the export performance of export companies. The product barrier occurs in developing new products for specific foreign markets, meeting export quality standards and packaging, adapting export product design/styles, and providing an after-sales service (Dichtl et al., 1984; Leonidou, 2004).

As indicated in Figure 1, if companies want to increase the volume of their coffee export, they have to first explore the variety of coffee markets. In order to meet the demands of different world markets, coffee export enterprises have to adapt their coffee products according to desired tastes, different quality standards and the variety in packaging for specific foreign market needs and wants. These requirements are the result of the different conditions of use in different countries, variations in purchasing power, dissimilar consumers, varying tastes, and diverse socio culture (Leonidou, 2004). Meeting the demands of different markets will increase the volume of coffee export. Although such adaptations are vital in gaining product acceptance and increasing company sales, they can pose several problems for a firm: (1) a rise in unit costs and consumption of time due to investment in developing coffee quality, flavour, packaging, and specifications (see loop B1); (2) ability to control exporting operations (see loop B2); and (3) variations in marketing support activities abroad (see loop B3). These problems are the causes of export volume reduction and have become a bottle neck for the development of Vietnamese coffee export activities.

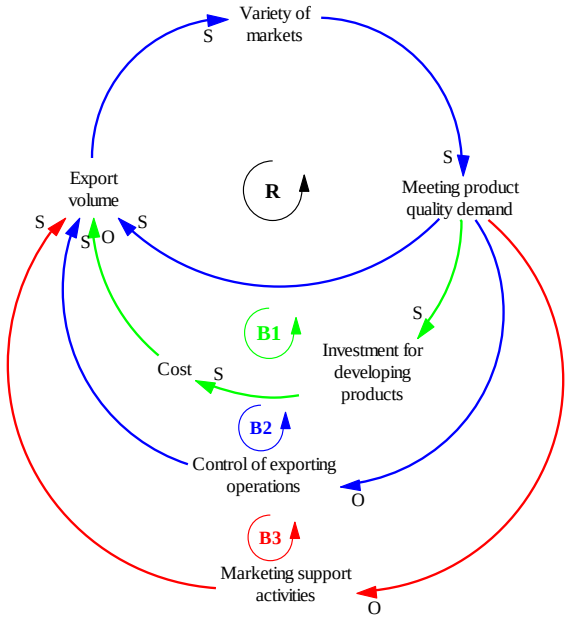

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Figure 1: Product barrier

Strategies: Vietnamese coffee export companies may overcome the product barrier by

— reducing the cost of developing new coffee products through the formation of strategic alliances with other companies with expertise in introducing new coffee products internationally or adapting the product (*such as Nescafe, Starbucks, Dallmayr, Caffé Vita Coffee Roasting Company, etc.),* as opposed to standardising it in each market;
— increasing marketing activities especially by supporting niche markets;
— increasing the ability to control coffee export operations in insecure and variable markets; and
— changing the way in which coffee is produced – adoption of improved production technologies to increase the productivity and quality of the product.
—

- ***Price***

The price barrier is a serious problem for Vietnamese coffee export firms because it has a significant effect on both customer satisfaction and competitors' price. In recent years, Vietnamese coffee enterprises had to increase coffee export cost due to the additional costs incurred in

✓ modifying the product, its packaging, and service in foreign markets;
✓ higher administrative, operational, and transportation expenses connected with exporting;
✓ extra taxes, tariffs, and fees imposed when entering the host countries; and
✓ the higher cost of marketing and distributing the goods in overseas markets (Piercy *et al.*, 1999).

It has therefore become very difficult to offer satisfactory prices to customers and to match competitors' prices for increased coffee export volumes (see Figure 2).

As indicated in Figure 2, when coffee export cost increases, it causes the export price to accelerate in order to retain a profit for the exporting enterprise. Thus, the ability to offer satisfactory prices to customers of coffee export companies will continue to reduce. If export companies want to increase their ability to offer satisfactory prices to foreign customers, they will have to increase the export price. This will in return lead to a decline in the offering of satisfactory prices for foreign customers (see loop B1). Another barrier to coffee export price is the difficulty to match competitors' prices. If the Vietnamese coffee export price increases, it will not match that of competitors. This leads to Vietnamese coffee products becoming less competitive than that of other countries.

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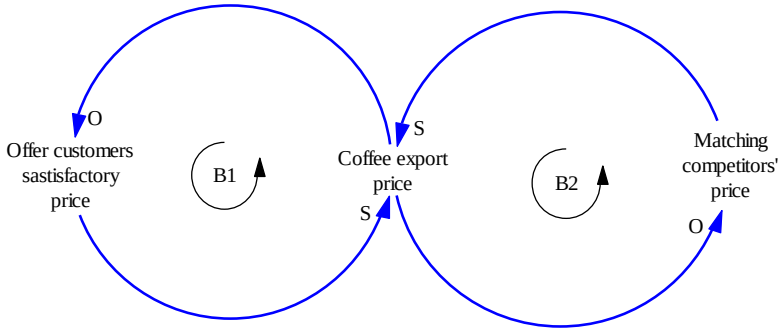

Figure 2: Price barrier

Strategies: The Vietnamese coffee exporters can reduce the impact of this problem by
— producing cheaper versions of coffee products; and
— operating in niche markets to enhance competitive advantages.

- ***Distribution***

The distribution barrier is one of the major challenges facing coffee exporters in Vietnam. Figure 3 indicates that growth in the ability to distribute coffee in international markets will increase the volume of coffee export. Increasing the coffee export volume requires an escalation in distribution ability in the overseas markets (see loop R).

This obstacle can be explained by
1. complex foreign distribution channels because the distribution channel is different not only between the home and host countries, but also between overseas markets;
2. accessing export distribution channels are difficult due to the fact that some channels of distribution are already occupied by competitors; and
3. obtaining reliable foreign representatives. It is very hard to find foreign representatives who would meet the structural (financial strength, facilities), operational (product assortment, logistical arrangements, coffee warehouse facilities), and behavioural (market reputation, relationships with government cooperative attitude) requirements of the exporter (Leonidou, 2004; Yannopoulos and Kefalaki, 2010). An increase in the distribution ability also leads to accelerated risks in coffee export. As the risks in coffee export increase, both distribution ability and export volume will decrease (see loop B1 and B2).

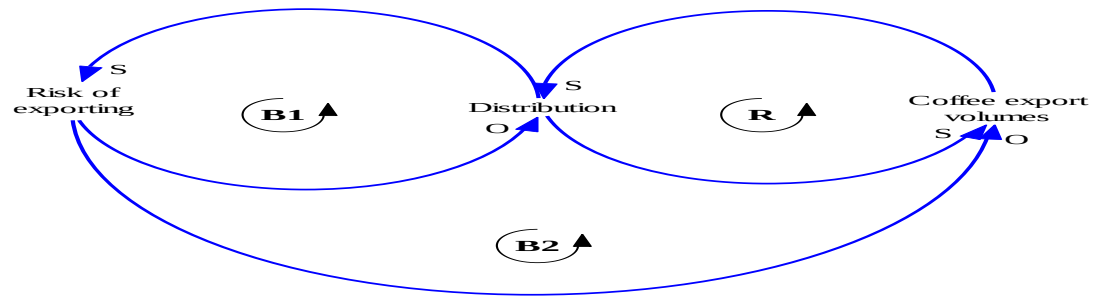

Figure 3: Distribution barrier

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Strategies: To reduce the distribution barrier, Vietnamese coffee export companies should:

— address the complexity in foreign distribution channels by adjusting their distribution;

— find ways to bypass the difficulty in accessing export distribution channels by seeking the assistance of international coffee export management companies which already have established distribution systems or have set up direct coffee distribution channels to consumers;

— obtain reliable foreign representation by attracting both traditional and new representation through offering higher profit rates.

- ***Logistics***

The logistics barrier can be seen as a further extension of the distribution barrier (Leonidou, 2004; Price and Nance, 2010). The logistics barrier refers to the difficulty in maintaining an adequate supply of stock in overseas markets, unavailability of foreign warehouse facilities, and excessive transportation and insurance costs (Julian and Ahmed, 2005; Yannopoulos and Kefalaki, 2010). The logistics barrier to Vietnamese coffee export is presented in a CLD (Figure 4). In this figure, the reinforcing loop (R) shows that an increase in the coffee export volume requires an increasing ability in three aspects. First, an increase in the provision of an inventory to overseas markets, because the exporters require an adequate supply of coffee products abroad to be able to deliver products in the case of unexpected events such as transportation delays or demand fluctuations. A lack in the ability to supply products in such cases may give rise to a number of disadvantages for the exporter, such as (1) a 'bad' image for Vietnamese coffee products in the foreign market; (2) lost sales and profits from potential and existing customers; and (3) extra costs when using forced to use faster transportation means. Many Vietnamese coffee export companies claim that the more distant the foreign market is, the greater the likelihood of experiencing product shortages. Secondly, an increase in coffee export volume leads to the problem of a lack of available foreign warehouse facilities. In some foreign markets there are either not enough warehouses available in which to store the coffee products or the proper installations (equipment technology) to safeguard coffee quality are out-dated. Finally, an increase in coffee export volume also escalates transportation and insurance cost. This is because distances from foreign markets are usually greater than in the case of domestic markets (Leonidou, 2004). Selling coffee abroad requires additional insurance coverage. An increased ability in all three these aspects can increase the cost of coffee products and subsequently the price that end-consumers have to pay. This is a crucial problem for Vietnamese coffee export enterprises, since it can seriously damage its competitiveness in international markets. This means that a surge in coffee export price will lead to an increase in volume export (see loop R in Fig.4), but the subsequent increase in the price of coffee will have a negative effect on customer satisfaction. In the long term, this will lead to a decrease in coffee export volume.

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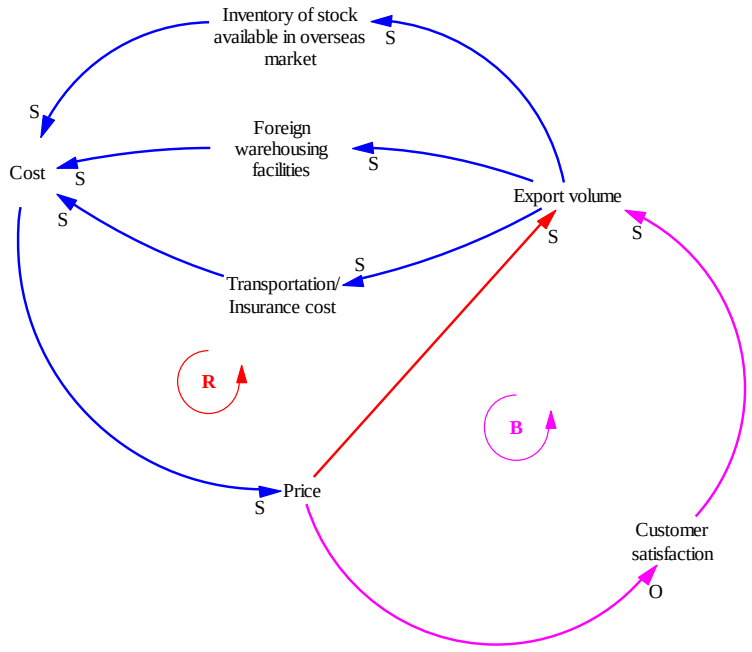

Figure 4: Logistics barrier

Strategies: To reduce difficulties in the coffee export logistics, the coffee export companies should:

— improve relationships with key local suppliers who have good infrastructures and facilities for coffee products;

— pay more attention to packaging and labelling in the host markets to reduce the cost of transportation, insurance, and inventory.

- ***Promotion***

The promotion barrier deals with adjusting export promotional activities to individual foreign market requirements in relation to the variations in buying motives, consumption patterns, and government regulations (Leonidou, 2004; Lewin et al., 2004). The effect of the promotion barrier to export performance for coffee export firms is at a moderate level (Leonidou, 2004). Figure 5 shows that both coffee export volume and foreign coffee markets are strongly influenced by export promotion activities. When export promotion activities increase, it can lead to a rise in the cost of the coffee product. Increasing cost of coffee products leads to not only a reduction in profit, but also in advertising activities in global markets. While reduced advertising (the message, advertising media, frequency and duration of advertising) leads to limited international markets (see loop B1), a decrease in export volume is also a cause of reduced coffee export profit (see loop B2). Both of these affect export promotion activities negatively.

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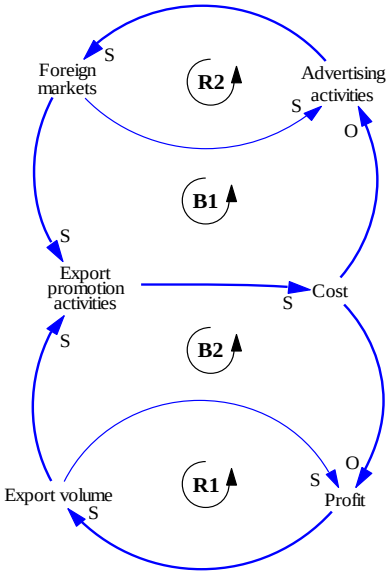

Figure 5: Promotion barrier

Strategies: Almost all the Vietnamese coffee export enterprises have limited promotional resources and low levels of competition. Coffee marketing efforts must therefore be judiciously targeted and professionally developed. The most efficient approaches focus on relationship building, such as exporter and roaster visits and trade shows, rather than on non-targeted advertising. Some useful promotional strategies such as E-Trade and business development, internal consumption campaigns, and market information systems should be applied in the coffee trade.

- ***Overall analysis of the internal barriers***

Figure 6 indicates the constraining effects of each of the eleven internal barriers (shown in balancing loops) on Vietnamese coffee export activities. Variety of product is the most influential problem encountered by coffee exporters. If coffee export enterprises want to increase their export volume, they need to expand their markets. In fact, this becomes a problem in countries where the customers are seeking a better quality, and require more attractive labelling/packaging/styles than those offered in the company's home market. To meet these requirements, coffee firms have to invest more in developing new products. However, higher investment in developing new products will lead to an increase in the cost of the product. As a consequence of increasing the cost, the volume of coffee export will decrease *(See balancing loop B3: Variety of products – Investment for developing products – Cost – Coffee export volumes – Variety of markets).*

Although most coffee enterprises in Vietnam take advantage of the low labour cost, the coffee export price is becoming a serious barrier due to the continuous increase in the cost of input materials. The price affects both competitiveness and customer satisfaction. As mentioned above, if coffee enterprises want to increase coffee export volume, they are required to expand their international markets via a bigger variety of coffee products for the niche markets. However, if this is expected to be successful it will mean higher costs due to the additional costs incurred in modifying the product, its packaging, transportation expenses, advertising and extra taxes in overseas markets. However, if prices escalate it will not only reduce competitive advantages (not matching that of competitors - see balancing loop B6: *Coffee export volume* –

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Variety of markets – Variety of products – Investment for developing product or Export promotion activities – Cost – Price – Matching competitors' price), but will also lead to a decline in customer satisfaction (see balancing loop B7: *Variety of markets – Variety of products – Investment for developing product or Export promotion activities – Cost – Price – Customer satisfaction*). As a result of the lack of price competitiveness, the coffee export volume will decline.

Three other common barriers in the coffee export industry were discussed, namely logistics, promotion and distribution. These barriers imply that when companies decide to expand their international markets, they have to (1) upgrade and establish a new supply inventory system *(see B4: Variety of market – Logistic system – Cost – Coffee export volume)*; (2) adjust promotional activity to individual foreign market requirements in a responsible way *(see B8: Variety of market – Export promotion activities – Cost – Coffee export volume)*; and (3) vary distribution channels *(see B9: Variety of market – Distribution – Coffee export volume)* in overseas markets. All of these lead to an increase in the cost or the risk in export activity and consequently a decrease in the volume of coffee export.

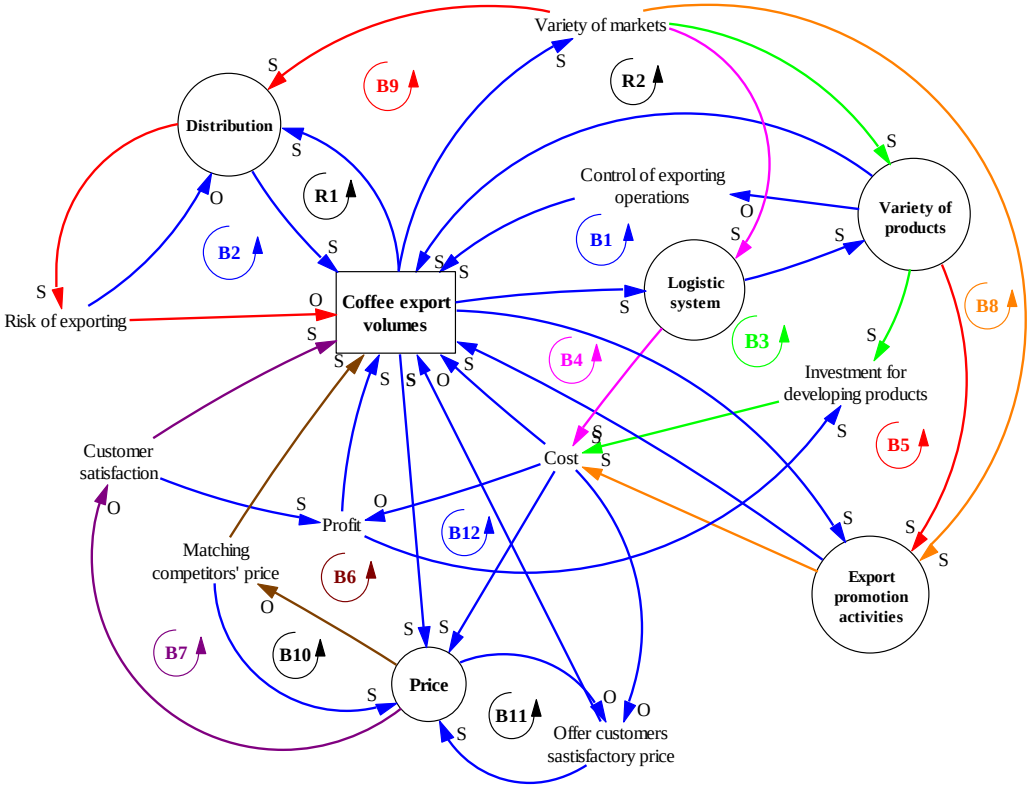

Figure 6: Overall analysis of internal coffee export barriers

In conclusion, there are several specific internal barriers to coffee export to overseas markets that warrant particular attention namely: *product, price, logistics, distribution, and promotion. These obstacles can be overcome by the internal actions of the coffee export firms. To overcome these barriers, enterprises should determine the causes of each type of barrier. For instance, a lack of information and knowledge about customer attitudes, preferences and habits may be the cause of providing coffee products that do not meet the customer's needs and wants. Therefore, a customer investigation in different markets may help to solve the root cause of the*

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problem. However, adapting product(s) to foreign market specifications is difficult because it may require a large initial investment, which many Vietnamese coffee exporters lack.

Analysis of the external barriers

- ***Government barriers***

Government barriers are the actions or inactions of the Vietnamese Government to support coffee exporters. Government agencies can be major promoters of coffee export activities by guaranteeing loans, providing updates on the information of coffee export prices and market data, and being party to interstate trade agreements. Thus, if coffee exporters receive strong support from the Vietnamese Government, the coffee export volume will increase (see balancing loop B1 in the Figure 7). Good support from government will also reduce rules and regulations with regard to Vietnamese coffee in host countries through trade agreements (see balancing loop B2 in Figure 7). However, an increase in coffee export volume requires expanding the foreign market, which will lead to an increase in rules and regulations, since each market has its own product standards, technical standards and rules (see reinforcing loop R in Figure 7).
In recent years, although the assistance of the Vietnamese Government (*for example: quality standard for each market, information on coffee price, demand for information, etc.*) has increased, some coffee exporters claim that they do not receive such assistance, or when this is offered, it is insufficient and does not satisfy the specific needs of the coffee companies. On the other hand, even though this assistance may be fully provided, there are instances of coffee exporters not being aware of how to make use of it.

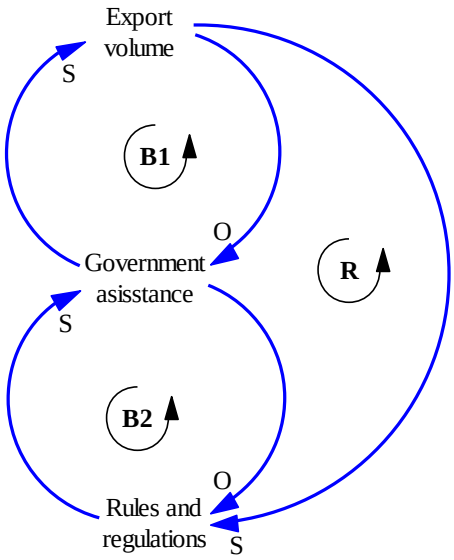

Figure 7: Governmental barriers

Strategies: The Vietnamese Government needs to:
— assure that the macroeconomic conditions and legal framework are conducive for coffee export enterprises;
— support coffee export companies by providing relevant information about coffee markets, attractive tax incentives programs, export promotion programs; and

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— provide a detailed overview of rules and regulations for overseas markets to exporters.

- ***Task barriers***

Task barriers focus on customers of Vietnamese coffee and Vietnamese coffee export competitors in the foreign markets, which can have an immediate effect on its export operations.

As indicated in Figure 8, an increase in the coffee quality will increase the satisfaction level of customers and meet the requirements of customer habits. However, this is an obstacle for Vietnamese coffee exporters, because customers living in different climatic conditions with different income levels and educational standards have clear differences in coffee product preferences, price acceptance levels, distribution systems, and methods for making a cup of coffee. Therefore, an increase in the investment to diversify products to meet customer requirements in different markets will lead to a reduction in the investment for upgrading the quality of coffee exporters' products (see balancing loop B1). This is due to a lack of capital and technology to produce a variety of products for different markets. Increasing coffee quality not only meets the requirements of consumer habits, but also reduces the number of competitors in the global markets. This is because some exporters don't have the ability to provide coffee products with high quality standards. Adjusting their product strategy to accommodate this will incur higher costs and create exporting delays. However, when competitors in overseas markets reduce, it will lead to a decline in the quality of Vietnamese coffee products because the pressure of increasing the quality of Vietnamese coffee exporters will reduce (see balancing loop B2).

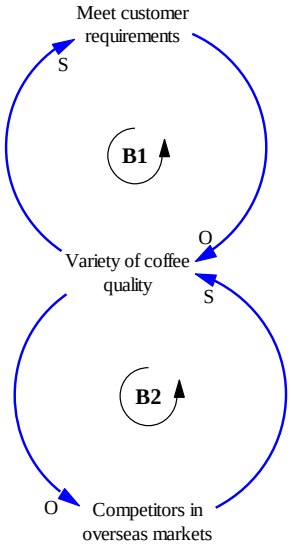

Figure 8: Task barriers

Strategies: To overcome this barrier, Vietnamese coffee exporters should adopt niche marketing as the most viable strategy to compete abroad.

- ***Business environmental barriers***

Business environment barriers refer to economic conditions abroad, and the political-legal and sociocultural environment of international markets. These barriers are usually difficult to

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predict and control. As illustrated in Figure 9, favourable environments in the host countries have positive effects on coffee export volume. However, these countries may not be attractive to coffee exporters due to poor or deteriorating economic conditions (low income per capita and inflation). The governments in these countries can impose a number of controls on exporters selling coffee products in their markets such as coffee price control, entry restrictions or special tax rates. These are serious barriers to coffee exporting. A favourable environment in the host countries has been seen as a solution to the problem of coffee exporting. Increases in export volume, an unintended consequence of this solution, also occur. This is because increasing the quantity of coffee export requires expanding international markets. As a result of this, the ability to control export activities of coffee exporters may reduce.

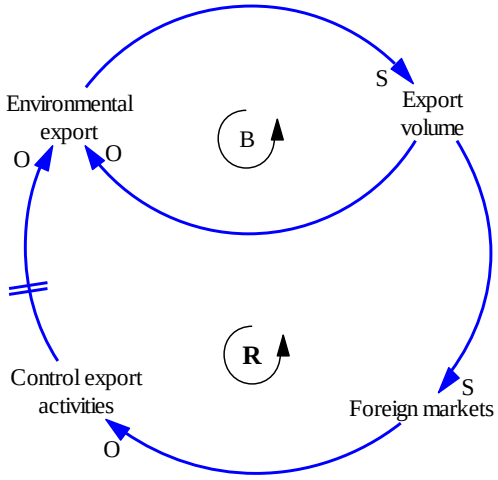

Figure 9: Business environmental barriers

Strategies: Coffee export firms need to intensively research the economic and social conditions of host markets before exporting their products and increasing cooperation with partners in importing countries.

- ***Overall analysis of external barriers***

Figure 10 shows the result of the obstructing effects of each of nine common external barriers (visible in the balancing loops) on Vietnamese coffee export. The most important external barrier is the assistance from the Vietnamese Government. Vietnam's agencies in foreign countries can guarantee loans, sponsor trade missions, be directly involved in interstate trade and organise trade fairs and agreements for coffee export activities. However, currently coffee exporters do not receive such assistance from the Vietnamese Government, which means that the export enterprises continue to face more rules and regulations in overseas markets. This leads to a reduction in the capability of the enterprises to produce coffee for exporting and as a consequence coffee export volume will continue to decline *(see balancing loop B2: Government assistance – Rules and regulations – Meeting product quality demand – Coffee export volumes).*

The export environment is also one of the most unpleasant external barriers encountered by coffee exporters. When coffee export enterprises want to increase export volume, they have to expand their markets. However, there are many differences between the home and foreign markets in relation to customer habits and attitudes, cultural traits and languages, economic

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conditions, tariffs, political environment and product standards and specifications. Expanding the overseas markets means that the exporters will experience increasing difficulties, which could lead to a reduction of the coffee export volume (see balancing loop B4, B5, B6, B7 and B8: *Coffee export volumes – Foreign market – Tariffs/Political instability/Language differences/Sociocultural traits/Economic conditions abroad – Export environment).*

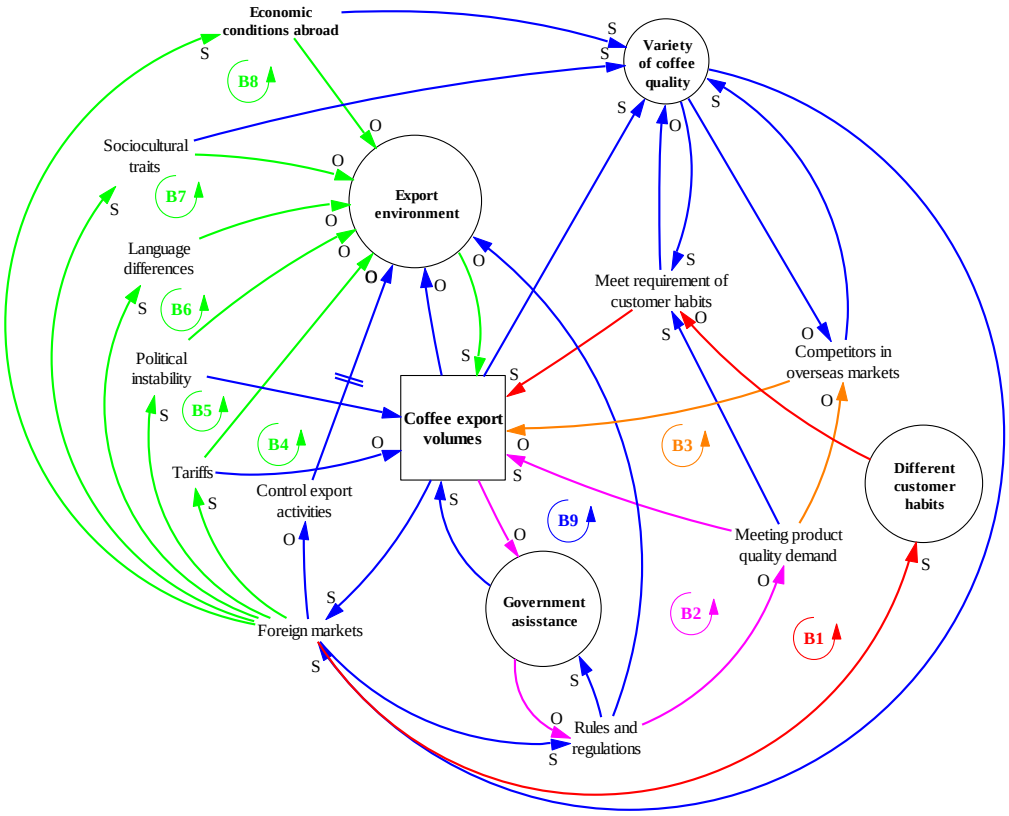

Figure 10: Overall analysis of external coffee export barriers

In summary, export environment, assistance of government and different customer habits are the most common external barriers that cause a reduction in the opportunities for exporting Vietnamese coffee products. These barriers cannot be overcome by the coffee exporter's internal actions or through education. Therefore, this study suggests that it is important for government program administrators to be aware of the perceived strategic limitations and when possible, find ways to help coffee export enterprises overcome these limitations. The Vietnamese policy makers need to augment the promotional, operational, and educational programs that they service in a bid to reduce the effects of perceived exporting problems. Such responses can be made in two ways. On the one hand, indirect efforts may be made through assisting in primary research activities to help coffee exports seek potential foreign market opportunities and identify suitable overseas representation. On the other hand, direct efforts may be made to provide export incentives and simplify regulatory procedures.

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CONCLUSION

The above discussion has demonstrated that there are many obstacles to the internationalisation of Vietnamese coffee companies. These are associated with internal weaknesses (such as the ability to have product variety, logistic ability, promotion strategies, and distribution ability) and external factors (e.g. the role of government and the political-legal and sociocultural environment of international markets). In general, internal barriers found within the country are more controllable and easier to manage while external problems occurring in the international market are difficult to manage. The systems thinking approach is a valuable methodology to identify how these obstacles or barriers affect the coffee export industry.

Overcoming the multiple barriers that have an effect on the coffee export companies will not be easy. It requires an understanding of the relationships between exporters and their import partners as well as the environmental factors in the different markets. Obstacles for managers of coffee export enterprises have been highlighted through the construction of a series of CLDs. Exploring the relationships helped to identify basic strategies for overcoming these obstacles in order to improve the competitive advantage of Vietnamese coffee products in the international market.

The results presented in this paper provide a better understanding of the complex influences of export barriers on Vietnamese coffee export activities. Although internal factors such as product, price, distribution, logistics and promotion may play a vital role in shaping the CLDs, other external barriers were shown to be highly relevant. These include task, government, and environment. Details of these CLDs do not only provide coffee export managers with a snapshot of the Vietnamese coffee export system and its obstacles, but also help to define basic strategies to overcome these difficulties. In forthcoming papers, the CLDs of export barriers will be developed further in order to be incorporated into the context of the overall coffee supply chain management system.

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CHAPTER 5

ENHANCING THE COMPETITIVE ADVANTAGES OF VIETNAMESE COFFEE THROUGH THE EXPLORATION OF CAUSAL LOOP MODELLING IN THE SUPPLY CHAIN

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Name of Principal Author (Candidate)	Thich V. Nguyen		
Contribution to the Paper	Designed and performed the survey, data analysis and interpretation, wrote manuscript, and acted as corresponding author		
Overall percentage (%)	85		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	8/2/2017

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);

ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Nam C. Nguyen		
Contribution to the Paper	Contributed to planning of the survey, discussions, proof-reading of manuscripts, data interpretation, and supervised development of work.		
Signature		Date	10/2/2017

Name of Co-Author	Ockie J.H. Bosch		
Contribution to the Paper	Supervised development of work, manuscript evaluation and correction.		
Signature		Date	12/2/2017

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Enhancing the competitive advantages of Vietnamese coffee through the exploration of causal loop modelling in the supply chain

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Abstract: Coffee supply chain management is the global operational strategy for enhancing the competitiveness of coffee companies. Enterprises are attempting to find ways to improve their competitiveness by changing their operation strategy through methods that include the implementation of the supply chain management paradigm. However, a thorough and critical review of existing literature is yet to be carried out in order to identify pertinent factors and gain useful insights into the role and effectiveness of causal loop modelling in coffee supply chain management. In this paper, researchers develop causal relationships among different variables that present enablers and outcomes – operating within many identified feedback loops. The resulting causal loop model provides coffee production managers with a snapshot of the dynamic interactions among elements in the coffee supply chain, which helps to identify proactive action in implementing the coffee supply chain philosophy for increasing the competitiveness of coffee products. Based on this review and analysis, recommendations are made regarding the application of the causal loop method in coffee supply chain management. Important future research directions are also indicated.

Keywords: coffee supply chain; causal loop diagram; CLD; competitive advantages.

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1 Introduction

In recent years, Vietnamese coffee enterprises have been seriously challenged in the race against international competitors to improve their competitiveness. Many companies have responded to the challenge by embracing a broad view of competitiveness. It is no longer solely the production, processing, exporting or retailing, but their strategy is starting to emphasise the management of competitiveness in all phases and aspects of the coffee industry, from production to retailing. Thus, supply chain management is becoming a top priority in many Vietnamese coffee companies.

Supply chain management is defined as

> "The systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long term performance of the individual companies and the supply chain as a whole."

It considered being one of the most powerful operation paradigms for increasing the competitive advantages of a product in the international market, including the improvement of customer value and satisfaction (Allmayer and Winkler, 2014). It has also played an important role in the competitive strategy for integrating suppliers and consumers with the objective of improving responsiveness and flexibility of enterprises to meet the changing market requirements (Chan et al., 2012; Priem and Swink, 2012; Vrijhoef and Koskela, 2000). Supply chain management has been increasingly applied as an operations paradigm for enhancing overall organisational competitiveness (Chiadamrong and Sophonsaritsook, 2015; Gunasekaran and Ngai, 2004). It is a set of approaches utilised to effectively integrate suppliers, producers, processors, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the appropriate times, in order to minimise costs and risks, while improving product quality and satisfying service to meet the requirements of all consumers.

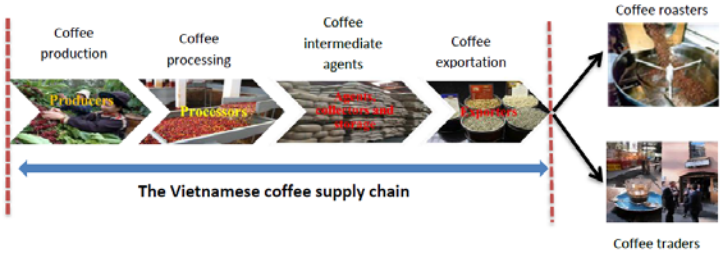
System dynamic modelling and systems thinking approaches have in recent years been widely applied in supply chain management, such as inventory decision and policy development (Lehr et al., 2013; Stave and Kopainsky, 2015; Trappey et al., 2012), supply-chain risk management (Vilko et al., 2012), supply chain design and integration (Christopher and Towill, 2001; Sabri and Beamon, 2000), reverse logistics (Ravi et al., 2011), international supply chains (Aschauer et al., 2015; Elkady et al., 2014; Trappey et al., 2012), the construction industry supply chain (Sundarakani et al., 2014), manufacturing systems (Ghorbani et al., 2014), and especially in studying complex logistic behaviour (Armendàriz et al., 2015; Aschauer et al., 2015; Minegishi and Thiel, 2000).However, most of the literature discuss only the implication of one or two aspects of supply chain management and do not cover the supply chain system in its entirety. Developing a comprehensive causal loop model for supply chain management to enhance the competitive advantages of coffee products has therefore been regarded as essential.

Such a model would be a powerful tool to identify the root causes for enhancing the competitive advantages of Vietnamese coffee and could also serve as a demonstration of the impact of changes in different elements in the supply chain. The main objective here is to address issues related to the identification of the important variables in coffee supply chain management, through the use of relevant feedback loops to develop a framework for the Vietnamese coffee supply chain for enhancing the competitiveness of Vietnamese coffee in the international market. This study especially focuses on developing causal loop models for the four main factors that influence the competitive advantages of coffee products, namely cost, quality, customer satisfaction and the competitors in the international market. Future research directions are also identified.

2 The Vietnamese coffee supply chain

The Vietnamese coffee supply chain is structured in a complex web of interrelationships that links production and consumption. Thus, the coffee product goes a long way and changes many hands from the cherry stage to the final cup of coffee. The four major players in the Vietnamese coffee supply chain include the producers, processors and intermediate agents and exporters (Figure 1).

Figure 1 General structure of the Vietnamese coffee supply chain (see online version for colours)



In Vietnam, coffee is produced by both households and companies. However, coffee production is mainly a 'family' activity, carried out by households on small farms of less than three hectares (Nguyen et al., 2015b). The producers sell the dry cherries to private traders, to agents of processing plants, or directly to processing plants.

Almost all coffee processing companies in Vietnam are primary processors. Primary processing involves the conversion of harvested coffee cherries into green coffee beans. There are two forms of technology for primary processing, namely dry processing and wet processing. After processing, the processors sell the green beans to either agents, exporters or a larger processing plant, and in some cases they also sell directly to international customers (coffee roasters, traders, and brokers). State owned companies with processing plants, including both state farms and specialised processor-exporters, are allowed to export directly.

Collectors (intermediaries) form the next stakeholder group in the supply chain and are involved in many aspects of the chain. They may buy coffee at any stage from coffee cherries to coffee beans. They go directly to the farmers' warehouses the or processors to purchase coffee cherries and/or coffee beans, which they then sell on to larger coffee processors or exporters. Before selling to these larger processing companies or exporters,

the collectors may do some of the primary processing work such as drying, grading or polishing of the beans to ensure standard moisture content, colour and bean size.

Exporters are the last stakeholders in the coffee supply chain. In Vietnam, the coffee export companies are not only involved in exportation, but in some cases they also become involved in the processing and transportation of the beans. There are currently around 150 registered coffee exporters (Gonzalez-Perez and Gutierrez-Viana, 2012), who buy coffee beans from intermediate agents/collectors or processors and then sell to dealers, brokers or roasters. In fact, most of their export sales are to agents of multi-national traders who receive the coffee at the port and ship it to their clients.

3 Research methodology

Causal loop diagrams (CLDs) are used to designate system elements and their relationships in the supply chain (from producers to retailers and between sellers and buyers). CLDs have become increasingly popular as a powerful methodology for obtaining insights into the problems of supply chain management. Georgiadis et al. (2005) mention that CLDs in a supply chain can assist strategic decision-makers in enterprises to form comprehensive models to guide them in their decision-making process to increase the profitability of the chain as a whole. Other examples include Minegishi and Thiel (2000) who proposed a model that shows how CLDs could contribute to improving the knowledge of the complex logistic behaviour of an integrated food industry; Towill (1996) states that a CLD is a powerful tool for predicting and prioritising management methods of a supply chain in order to achieve enhanced performance when viewed from the perspective of all stakeholders in the chain.

CLDs or models are a valuable tool to sketch the causal relationships and help to conceptualise the real world systems in terms of feedback loops. In a CLD, each connection (line with arrow) between two factors has a corresponding sign (‘+’/‘S’ or ‘–’/‘O’) that indicates the direction of the causal link between variables. Connections with a ‘+’/‘S’ sign indicate that whichever direction the input variable changes (increase or decrease), the output variable will change in the same direction. In contrast, connections labelled with a ‘−’/‘O’ sign indicate that the output variable will change in the opposite direction.

Supply chain management is “An integrating philosophy to manage the total flow of a distribution channel from supplier to ultimate customer” (Cooper and Ellram, 1993). The flows often create significant feedbacks between the partners of the extended chain. Therefore, developing a CLD is an appropriate tool for strategic supply chain management. It helps managers to better understand the interactions among various factors which influence the success of supply chain management.

The steps followed in developing the CLDs are based on the guidelines set by Cavana and Maani (2000). The main objective of this study is to use the model to assist in determining how to increase the competitive advantage of Vietnamese coffee through supply chain management. Therefore, the following adapted steps were followed:

1 identify main elements/variables that are involved in the coffee supply chain

2 establish the links between related elements in the CLD of the coffee supply chain

3 indicate the direction (polarity) on each link

4 identify and label the reinforcing or balancing loops in the diagram of the coffee supply chain system

5 identify key leverage points in the coffee supply chain where interventions could increase the competitive advantages of the coffee product

6 identify and develop systemic intervention strategies to manage the Vietnamese coffee supply chain more effectively.

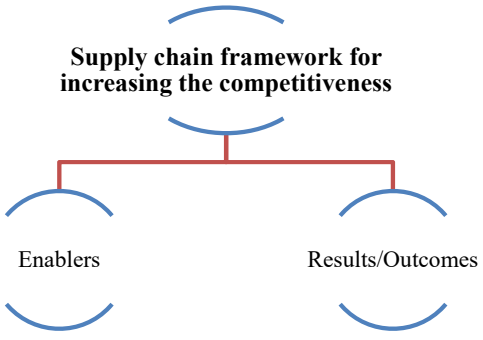
A key feature of this process is to create a diagram in order for the CLD to be used as a basis for developing actions and implementing supply chain management strategies. In this study, developing a CLD for the Vietnamese coffee supply chain has been developed after detailed discussions with coffee producers, intermediate agents, coffee exporters, local officers and experts during a workshop conducted in the central highland of Vietnam, an area which is considered as the 'coffee capital' of Vietnam (see Figure 9). During the workshop participants were divided into small groups in which the participants were representing the same part of the supply chain. Second, these individual groups were required to create a CLD for each individual stage or part of the supply chain in which both internal and external relationships between elements in the coffee supply chain were identified. In the next stage of the workshop, each stakeholder group was asked to review and add more variables to the CLD which had been developed by another group. Last, a general CLD that shows the correlations among coffee supply chain stages was developed by combining all the CLDs. This general CLD was revised by Vietnamese coffee experts who are familiar with the real Vietnamese coffee industry situation.

4 CLDs in Vietnamese coffee supply chain management

4.1 Identification of main variables

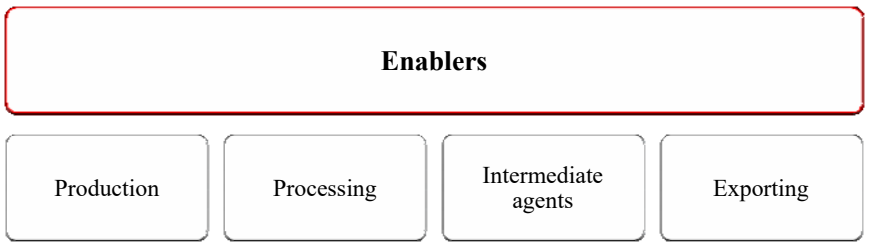
The key variables are indicated in the generic framework of the coffee supply chain model. These can be divided into two parts; the enablers and the outcomes or results (Figure 2).

Figure 2 Coffee supply chain framework model (see online version for colours)



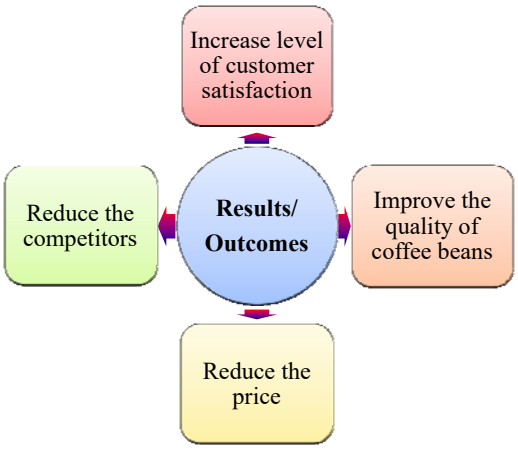
In this study four variables have been identified as enablers namely; production, processing, intermediate agents, and exporting (Figure 3).

Figure 3 Identification of coffee supply chain enablers (see online version for colours)



In the context of the Vietnamese coffee supply chain, four variables have been identified as the main contributors to the competitive advantages of Vietnamese coffee product: namely the level of customer satisfaction, quality of the product, the competitors, and the price (directly impacted by cost) (Figure 4).

Figure 4 Identification of Vietnamese supply chain variables of results/outcomes (see online version for colours)



4.2 Developing CLDs

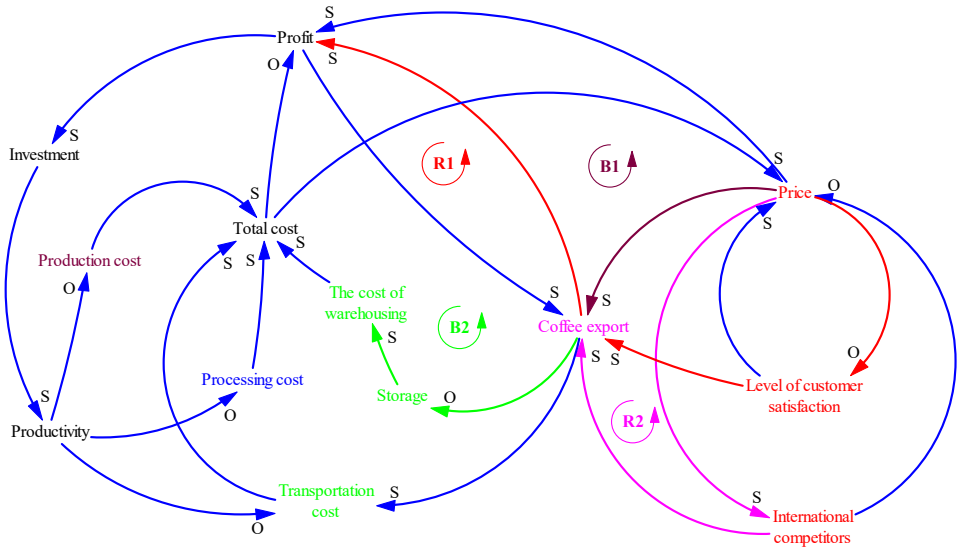
A CLD in supply chain management has been proven to be one of the most powerful tools for organisations to achieve a competitive advantage in the global market. It can help managers to classify the roles of stakeholders, identify the key capabilities to structure each collaborative relationship, and evaluate the stakeholders' readiness to collaborate.

This study has developed causal diagrams of four key aspects which determine the competitive advantages of the coffee product (price, quality, customer satisfaction, and competitors). The results of the steps used to end up with a general diagram of the Vietnamese coffee supply chain are discussed in the following sections.

4.2.1 CLD of cost in the whole coffee supply chain

The price of coffee is determined by the total cost and a change in the total cost will lead to a change in price. Price is the first aspect of the competitiveness of a product. Therefore, most coffee companies aim to keep their pricing competitive in order to attain a higher profit or a larger market share than their competitors. In the CLDs of total supply chain cost (Figure 5), there are two positive feedback loops and two negative feedback loops that show correlations related to the cost of the coffee product in a supply chain. In this case the two positive feedback loops are virtuous cycles (R1 and R2) and the two negative feedback loops are vicious cycles (B1 and B2).

Figure 5 CLD of the coffee supply chain cost (see online version for colours)



R1 (*Price – Level of customer satisfaction – Coffee export – Profit – Investment – Productivity – Production/Processing/Transportation cost – Price*) shows that the effect of price on customer satisfaction is significant. A reduction in the price of coffee in the foreign markets will increase the level of customer satisfaction. This can be explained by the fact that there are variations in the purchasing power of different consumers in the international market. The volume of coffee exported is strongly affected by customer satisfaction. Thus, an escalation in the level of customer satisfaction will lead to an increase in the volume of coffee exported. The profit made on coffee increases as a result of an increase in export volume. It is important to note that an increase in profit will lead to increased investment by the coffee companies at all the different stages of coffee production. Therefore, the productivity of all elements in the supply chain will increase (including production, processing, packaging and transportation). This increase in coffee productivity will then lead to a decline in the cost of production, processing, packaging and transportation. The total coffee supply chain cost is determined by the costs of these components. The Vietnamese companies will be in a position to offer coffee at a lower price in the international markets if the cost of each unit is reduced. Price could therefore be used as a very effective marketing tool to increase the competitive advantages of

Vietnamese coffee in the global markets. R2 is similar to R1, the only difference being the addition of the variable *International competitors*, which also directly impacts on coffee export volume.

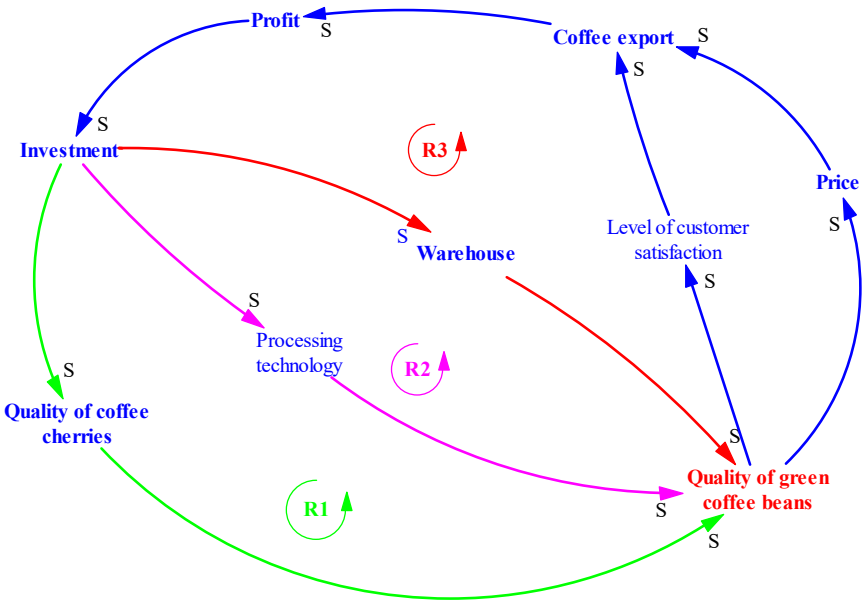
B1 and B2 are vicious cycles (Figure 5). B1 (*Total cost – Price – Coffee export – Profit – Investment – Productivity – Production/Processing/Transportation cost*) illustrates that the reduced total cost of a coffee supply chain leads to a reduced coffee price in the international market. This can be explained that when the total cost of product is low, the producers will be willing to supply their products at a lower price in the international market. However, a decline in the coffee price in the international markets will lead to a decrease in the coffee export volume because the coffee exporters have to consider any possible profit to be made for the firm. The less coffee exported, the less profit they will receive. A reduction in the profit requires supply chain members to cut down continued investment in all stages of the supply chain (production, processing and warehouse facilities). This will eventually lead to a reduction in productivity in all stages since the supply chain members will have to return to using old fashioned facilities. The unit cost of coffee will increase in all stages due to the decline in productivity. As a result, the total cost of coffee will increase again. The higher cost of Vietnamese coffee will lead to a reduction in its competitive advantages in the international coffee markets.

The B2 (balancing loop) is formed by adding the variables *Storage* and *Cost of warehouse* (instead of the variables *Profit*, *Investment*, *Productivity* and *Cost of different supply chain members*). The decline in the coffee price in the global markets will have a negative effect on the volume of coffee export. This happens because when coffee export volume reduces, more warehouses are required for storage which leads to an escalation of the cost of warehousing the coffee. As a result, the total costs in the coffee supply chain will rise. Finally, as a result of the increase in total cost, the coffee exporters have to sell their coffee at a higher price to remain profitable which, in turn, affects the competitive advantages of Vietnamese coffee in the international markets.

4.2.2 Causal loop diagram of the coffee quality in the coffee supply chain

In the Vietnamese coffee industry, a high coffee bean quality is a prerequisite to achieve the benefits of the supply chain. It is a core factor to increase the profit for all channel members in the supply chain. This is partly due to the fact that quality can affect an increase or decrease in the price in the international markets, and partly because it creates customer satisfaction, which leads to an improved competitive position in the international markets. Coffee quality is therefore considered to be a key competitive issue in the global marketplace. If the quality of coffee increases, it will lead to an increase in customer satisfaction and consequently a higher price in the market (Figure 6). This leads to an increase in coffee export volume and as a result of this increase in export volume, the profit made on coffee will increase in all stages in the supply chain. When all members in the coffee supply chain receive high profits, they will continue to invest more in their chain (production to increase coffee cherry quality, processing technology to reduce the duration of processing, warehouses to maintain quality) to increase coffee quality.

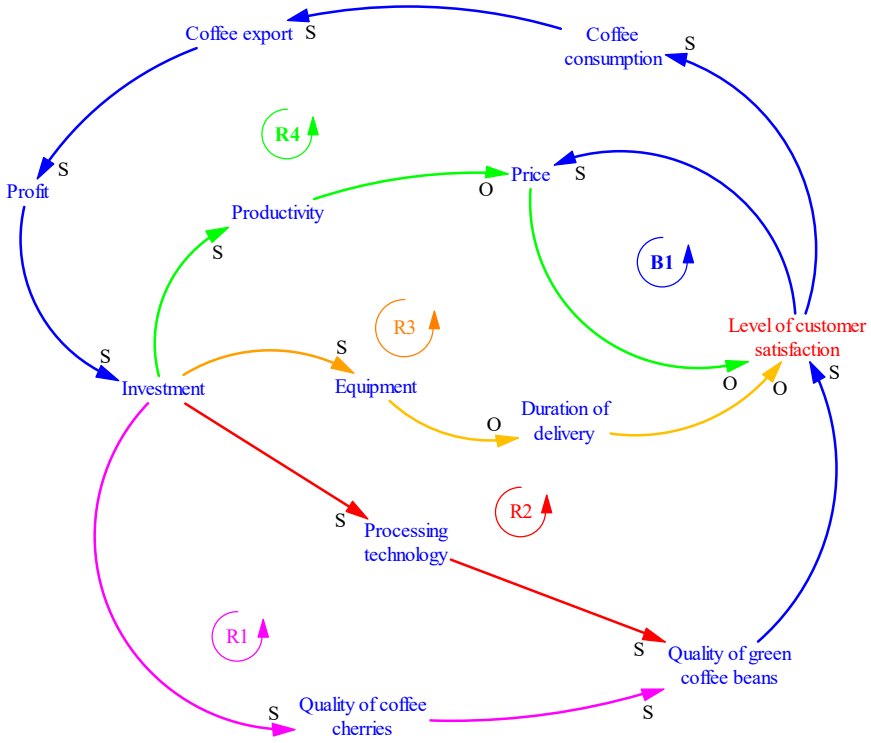
Figure 6 CLD of coffee bean quality in the supply chain (see online version for colours)



4.2.3 CLD of customer satisfaction in the coffee supply chain

Customer satisfaction with the coffee is often considered as having a pivotal role in any Vietnamese coffee company's success and long term competiveness in the global market. It is also viewed as a central determinant, a key differentiator of customer retention and has increasingly become a key element of their business strategy. The level of customer satisfaction is often decided by three main factors, namely the quality, price and time it takes to deliver the coffee (Figure 7). The quality of coffee plays a large role in increasing the level of customer satisfaction and it also influences customer loyalty. The price of coffee is another factor that has a strong effect on customer satisfaction. Thus, a change in price will lead to a change in the level of customer satisfaction with the coffee. Furthermore, if the delivery time of coffee reduces, customer satisfaction will increase. An increase in the level of satisfaction with Vietnamese coffee will have a positive effect on coffee consumption, and therefore lead to an increase in coffee export volume. This, in turn, affects profitability. When the profit increases, investment will be increased in all stages of the chain. This will lead to a reduction in price and time to deliver as well as an increase in the quality of coffee through increased productivity and better equipment and technology.

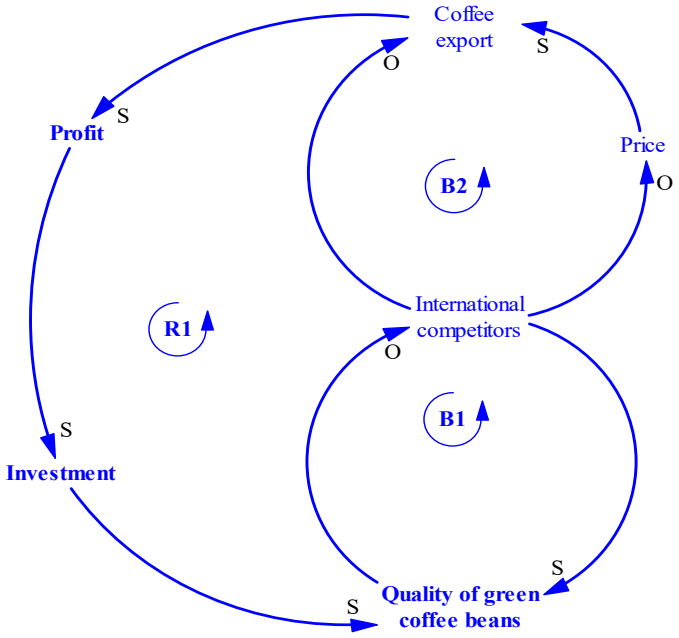
Figure 7 CLD of customer satisfaction in a supply chain (see online version for colours)



4.2.4 CLD of international competitors

Competition amongst companies plays a central role in measuring competitiveness. Suppose the price of Vietnamese coffee rises to such levels that even the ideal consumer of Vietnamese coffee finds it uncompetitive, they would then buy coffee products from other competitors instead. This would lead to a reduction in the export volume of Vietnamese coffee (Figure 8). Lower export volume fetches a lower profit for the coffee industry. As a result, the investment in all stages in the coffee supply chain will also reduce. It is clear that the quality of coffee beans is affected by seeds, fertilisers, processing technology, and storage which are all directly affected by investment (Nguyen et al., 2015b). If the investment in the coffee industry reduces, the quality of the coffee beans will also decline. When the quality of coffee declines, the number of competitors will increase because many other producers in the world can also provide the same or even better quality coffee. In this case, Vietnamese coffee will lose its competitive advantage, which would result in a decrease in the price of Vietnamese coffee in the international market.

Figure 8 CLDs of international competitors in coffee supply chain (see online version for colours)



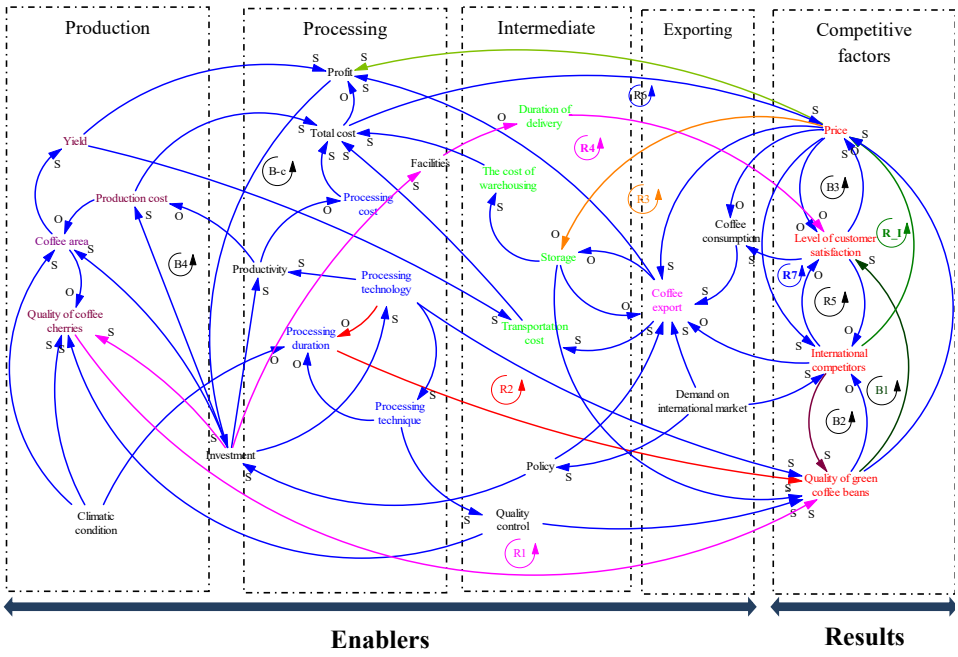
4.2.5 General CLD of the Vietnamese coffee supply chain

A general CLD of the Vietnamese coffee supply chain has been developed after detailed discussions with numerous experts from different stakeholder groups in the coffee industry. Various positive and negative feedback loops are shown in Figure 9.

Figure 9 shows that increased investment will tend to increase two aspects of competitive advantage; the level of customer satisfaction and the quality of coffee beans (see loops R1, R2 and R4). Both customer satisfaction and the quality of coffee are key competitive issues in the global marketplace. Increased investment will increase the quality of seed and fertilisers, and the effectiveness of irrigation systems in the production stage. This would lead to an increase in the quality of coffee cherries that directly affects the quality of coffee beans (see loop R1: *Investment – Coffee cherries – Quality of green coffee beans – Level of customer satisfaction – Consumption – Coffee export volume – Profit*). Increased investment also reduces the duration of the coffee beans processing process, because coffee companies can afford to upgrade the technology used in both the dry and wet processing methods. This also leads to an increase in the quality of coffee beans (see loop R2: *Investment – Processing technologies – Processing duration – Quality of green coffee beans – Level of customer satisfaction – Consumption – Coffee export volume – Profit*). When the quality of green beans improves, the consumption of coffee will increase because the number of satisfied customers will increase. This will have a positive effect on coffee consumption in the global market, which will increase the demand for coffee to be exported. A higher volume of coffee exported will result in higher profits for all stakeholders in the coffee supply chain. As a result of this, the investment ability of all channel members in the Vietnamese coffee

industry will continue to escalate. Thus, the feedback loop between investment, quality of coffee beans, and level of customer satisfaction, coffee consumption, coffee export and profit is a positive loop.

Figure 9 CLD of Vietnamese coffee supply chain (see online version for colours)



Customer satisfaction is strongly affected by investment. Increased investment in facilities and equipment will affect the duration of delivery of the coffee product from producer to end customers (see R4: *Investment – Facilities – Duration of delivery – Level of customer satisfaction – Consumption – Coffee export volume – Profit)*. The facilities and equipment are critical in securing a constant flow of coffee products from supplier to end customers, not only in achieving timely delivery, but also in maintaining the high quality levels of the coffee product. Thus, if coffee companies have proper facilities and equipment, the duration of delivery time will reduce. As a result of this, traditional customers will not only feel more satisfied but they will also remain loyal to the Vietnamese brand of coffee. This will also lead to an increase the number of satisfied customers, which will lead to an increase in the consumption of coffee which leads to an increase in profit for the Vietnamese coffee supply chain through the increase in the volume of coffee exported. When profit increases, the investment in all stages of the supply chain will also increase. This, in turn, will increase the competitive advantages of Vietnamese coffee through improving the level of customer satisfaction. This feedback loop is a reinforcing (or positive) loop.

Increased investment will lead to a reduction in the price of coffee (note that price is an important factor in the competitive advantage of any coffee product. It is influenced by the costs which are incurred across the coffee supply chain). A reduction of the coffee price leads to an increase in its competitiveness as price is one of the key determinants of customer satisfaction. If the coffee companies increase their investment, they will be able

to invest in modern technology in all the different stages of the supply chain (machines for production, new technology for processing, better facilities and equipment for transportation and storage, infrastructure etc.) which all lead to higher productivity (see loop B_c: *Investment – Productivity – Cost – Price – Coffee export volume – Profit*). As a result, the cost of all stages in the supply chain (production cost, processing cost, transportation cost, storage cost) will decline. Thus, the total cost of coffee will also decline which means the price of coffee will reduce as coffee exporters will be willing to sell at a lower price while they will still receive their expected profit. The increased volume of coffee export is a result of reducing the price. This can be explained by the fact that the lower price will also attract other potential customers who have different purchase powers. Increased coffee export volume will lead to an increase in profit which is a major cause of increased investment by all channel members. Thus, the feedback loop between investment, productivity, cost, price, coffee export and profit is a balancing (or negative) loop.

Investment is also strongly effected by international competitors; an increase in the number of competitors in the global market not only requires an increase in the coffee quality, but also a decrease in the coffee export price to maintain the competitive position of Vietnamese coffee in international markets (see loop R_I: *International competitors – Price – Coffee export volume – Profit – Investment – Quality of green coffee beans*). This leads to a bottle neck in the Vietnamese coffee industry. Vietnamese coffee faces strong competition in the global market because of the high number of other coffee producers and processors as well as traders. Thus, if the number of competitors who enter the international market increases, the Vietnamese coffee companies have to offer a lower price which will be comparable to that of their competitors. However, a decline in the coffee export price leads to a decrease in export volume because the Vietnamese coffee export companies then have to reconsider their export strategy to maintain their profit. The profit of coffee companies is strongly influenced by export volume. Therefore, a decrease in coffee export volume will lead to a reduction in the profit which has a direct effect on investment by all stakeholders in the supply chain. A decrease in the quality of coffee beans is a result of reduced investment in seed, facilities, equipment and technology by all coffee channel members. The resulting lower quality of Vietnamese coffee in the global market will lead to an increase in the number of competitors as many other coffee traders can also provide coffee products with the same quality as that of Vietnam. The loop R_I is therefore a reinforcing loop.

There is a clear relationship between the investment in elements of the supply chain and the competitive advantages of Vietnamese coffee in the international market. This is because the increase in investment will directly affect the quality, price and delivery time of the coffee, all of which are key factors affecting the competitiveness of coffee.

The price, which is affected by the cost of all stages in the supply chain (production cost, processing cost, transportation cost, storage cost), not only affects customer satisfaction, but also competition in the international market (see loop B3 and R7 in Figure 9). The negative feedback loop B3 (*Price – Level of customer satisfaction*) shows the effect of price on the level of customer satisfaction. The price is one of the key determinants of customer satisfaction because buyers prefer a low priced product to a high priced product. Therefore, when the coffee price increases, the customer satisfaction will decrease. This leads to a decline in the competitiveness of the coffee product in the pricing war strategy. As a consequence, the price of the product will also decrease. Customer satisfaction is most important from the coffee exporter's point of view because

it has a positive effect on the support for the exported product (Nguyen et al., 2015a). Thus, the coffee exporters will always prefer to offer a lower price to the customer in order to achieve high customer satisfaction.

The loop R7 (*International competitors – Price*) illustrates that an increase in the price of coffee in the international market leads to an increase in the number of coffee providers. It has been proven that the coffee traders tend to export their product to obtain a higher profit rather than sell it in the domestic markets when the coffee price in the global market is high. In contrast, a decline in the international coffee price will lead to a decrease in the number of coffee exporters in the overseas markets.

The aforementioned CLDs of the coffee supply chain provide an insight into understanding the dynamic interactions among the subsystems of the Vietnamese coffee supply chain. The CLD of the coffee supply chain has been developed after researchers spent considerable time creating the various causal relationships and feedback loops. It provides an understanding of these relationships, and it allows coffee companies to take proactive action to ensure the effective implementation of the coffee supply chain philosophy. The CLD of the Vietnamese coffee supply chain can be used to identify potential leverage points for intervention to increase the competitiveness of Vietnamese coffee products.

5 Conclusions

To date, most studies undertaken to enhance the competitive advantages of Vietnamese coffee have focused on a wide range of issues and generally are quantitative analyses. In this paper, a systems thinking approach provides a structured method to develop a shared understanding of a CLD for a coffee supply chain. This is known as a qualitative approach. The model building process, based on systems thinking, is very valuable in that it identifies not only the critical success factors for supporting an increase in the competitiveness of the coffee product via a supply chain, but also the causal relationships between these factors.

There are several contributions of this paper to the knowledge of supply chain management. First, the CLDs in this study serve as a simple visual representation of the complex relationships between key variables in the Vietnamese coffee supply chain. Once developed, the model can be used to identify potentially leverage points for interventions in enhancing all the four aspects of the competitive advantages, namely the level of customer satisfaction, the quality of the product, the degree of competition experienced, and the price of the product. The investment in all elements has a significant influence on, and the ability to make changes to, the supply chain system. Thus, it plays a crucial role and can also be considered as a potential high leverage point for intervention to increase the competitive advantages.

Second, details of the CLDs developed during this study have been valuable in identifying the means to enhance the competitive advantages, to provide coffee managers with a snapshot of the Vietnamese coffee industry system, and to identify leverage points for developing competitive advantage strategies for the Vietnamese coffee industry. There are a total of four enablers for increasing the competitive advantages for the coffee sector: production, processing, intermediate agents, and exporting. They influence four results: impact on the quality of product, customer satisfaction, price and international competitors. A general CLD of the whole coffee supply chain has been developed for

these sets of enablers and results and is the basis for continued analyses and research to find intervention strategies for increasing the competitive advantage of Vietnamese coffee.

Limitation of this research focuses on only identification of the important variables in coffee supply chain management, through the use of relevant feedback loops to develop a framework for the Vietnamese coffee supply chain for enhancing the competitiveness of Vietnamese coffee in the international market, but not assess how these variables impact on the competitive advantages of coffee product. Therefore, in a forthcoming paper these variables and its influences will be tested by using Bayesian Belief Network modelling.

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CHAPTER 6

IDENTIFYING KEY SUCCESS FACTORS IN SUPPLY CHAIN MANAGEMENT FOR INCREASING THE COMPETITIVE ADVANTAGES OF VIETNAMESE COFFEE

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Overall percentage (%)	85		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
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ii. permission is granted for the candidate in include the publication in the thesis; and

iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

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IDENTIFYING KEY SUCCESS FACTORS IN SUPPLY CHAIN MANAGEMENT FOR INCREASING THE COMPETITIVE ADVANTAGES OF VIETNAMESE COFFEE

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Keywords:	Coffee supply chain, competitive advantage, leverage points, supply chain management, systems archetypes, Bayesian Belief Networks

IDENTIFYING KEY SUCCESS FACTORS IN SUPPLY CHAIN MANAGEMENT FOR INCREASING THE COMPETITIVE ADVANTAGES OF VIETNAMESE COFFEE

Abstract

Purpose: To identify the leverage points in the Vietnamese coffee supply chain that would be intervened for increasing the competitive advantages of the product.

Methodology: A sequential approach by combining two established modelling techniques (Causal loop diagram and Bayesian Belief Networks - BBNs) was applied to identify the leverage points in the Vietnamese coffee supply chain for increasing the competitive advantages of the product. Data for the study were collected from a series of workshops and in-depth interviews with numerous relevant stakeholders of the coffee industry in the central highland of Vietnam.

Findings: The systems archetypes were developed and sensitivity analysis was used to identify potential factors that would increase the competitive advantages of coffee production. The results indicate that higher investment in all elements of the coffee supply chain will lead to enhanced competitive advantage.

Originality/value: Supply chain management (SCM) has become a potentially valuable way to improve the competitive advantages since competition is no longer only between organizations, but also among supply chains. Therefore, this research focus on enhancing the competitive advantages of production via supply chain management.

Keys words: Coffee supply chain, supply chain management, systems archetypes, competitive advantage, leverage points, Bayesian Belief Networks.

INTRODUCTION

In today's competitive business world, enterprises have to continuously improve and maintain their global competitive position in order to sustain long-term growth and profitability. Therefore, questions about the identification of the competitive advantages of the product have become increasingly important. In the search for potential improvement of the competitive advantages, enterprises need to focus on the basis of product innovation, quality improvement, and always at the lowest attainable costs (Henriques *et al.*, 2013). Firms which have effectively managed supply chains can achieve these competitive dimensions and will continue to be the winners in contemporary business. However, enterprises began to realize that they cannot improve the competitive advantages by themselves, but the whole supply chain can improve the competitiveness through cooperation of all the stakeholders in the chain to increase the quality and reduce the cost of the their products (Wognum *et al.*, 2011). Therefore, the role of supply chain management (SCM) has become an essential prerequisite for increasing the competitiveness of products and also for enhancing the enterprises' profitably.

The supply chain (SC) is a combined system which consists of the integration of activities through upstream and downstream linkages, indifferent processes that produce value in the form of products and services in the hands of the ultimate consumers (Christopher, 1992). Thus, supply chain management (SCM) is considered as an integrated approach towards increasing the effectiveness of the supply chain through improved coordinated efforts between upstream and downstream organizations in the system (Frohlich *et al.*, 2001). It is often used as the popular strategy in different studies for increasing organizational competitiveness and product competitiveness in the global race. Although there have been various studies that focus separately on different aspects of supply chain management to increase the competitive advantages. For example, Ellram *et al.* (1990), Spekman *et al.* (2002), and Chan *et al.* (2005) focused on correlations and effective cooperation among stakeholders in the supply chain to reduce substantial cost and cycle time. Rahman (2002) studied the cause and effect on the dynamic nature of supply chains to the formulation of supply chain growth strategies. Cooper *et al.* (1997), Lusch *et al.* (1996), Salcedo *et al.* (2000), and Nishat Faisal *et al.* (2006) presented the role of sharing information among supply chain members for planning, monitoring processes, also help to mitigate risk in a supply chain. In addition, Drozdowski (1986) and Treleven (1987) focused on new product development, product portfolio decisions, and design of quality control and delivery systems in all supply chain members for enhancing the competitive advantages. Furthermore, for a supply chain to succeed in increasing the competitiveness, La Londe *et al.* (1994) suggested that all supply chain members should have the same goal and the same focus on serving customers. However, these publications are not focusing on the search for potential leverage points of the links in the supply chain members which are the key to achieve sustainable competitive advantages for the products and/or services. Therefore, identification of leverage points in a supply chain system is essential for increasing the competitive advantages because the leverage points are places within a complex system where "a small change in one part can produce substantial changes throughout the whole system" (Meadows, 1999). The problem arises; what factors are the leverage points in the coffee supply chain?, How to identify these leverage points?, what is the most important factor for enhancing the competitive advantages of coffee product?, and Which interventions should potential be implemented?. The main purpose of this study is therefore to identify the leverage points where systemic interventions can be implemented to increase the competitive advantages of the product in the Vietnamese coffee supply chain as a whole. The study employs a systems thinking approach to identify the leverage points and applies Bayesian Belief Networks (BBNs) modelling for testing different scenarios that could reveal the systemic interventions required. This research offers useful guidance for implementing SCM practices in the Vietnamese coffee industry and potentially facilitates further research in different sectors.

METHODOLOGY

Two methods have been applied in this study to work with numerous specialists in the Vietnam coffee industry, embracing an integrated management approach. The first is a systems thinking approach which

was used to map the mental models of the stakeholders. This provides a conceptualization of the system based on the stakeholders' perspectives of the whole coffee supply chain. This 'map' is also used as a mechanism for identifying potential leverage points within the system (through developing system archetypes). The second one is Bayesian Belief Networks (BBNs) modelling approach. This approach was applied to find the systemic intervention strategies to implement within the coffee supply chain system in order to increase the competitive advantages of the Vietnamese coffee product in the global market.

- **Systems Thinking**

Systems thinking is one of the five disciplines that Peter Senge has considered as the core of a learning organization (Van Eijnatten, 2004). However, it requires a full understanding of the multiple relationships between elements or segments of a system. The aim of systems thinking is to discover the structure behind the observed system dynamics; therefore it can be understood and affected, if desired. It helps to describe how a system is interconnected with feedback loops that create the nonlinear behaviour that is frequently associated with modern day problems.

Systems thinking is a set of knowledge, tools and principles which provides a "new way of thinking" to understand and manage complex problems. It helps to see wider connections and influences between various parts or segments of a system (Bosch *et al.*, 2013). Systems thinking has been applied in a variety of disciplines and systems (Van Eijnatten, 2004). It starts by identifying the key variables that affect a system and tracing their patterns over time. These variables are used to identify cause and effect relationships that form the feedback loops of the system. The causal relationships between variables are identified to determine how one variable influences another. These relationships then can be diagrammed by links and result in loops. The loops can be either balancing (B) or reinforcing (R), depending on variable sets of a stable response (balancing loop) or an unstable response (reinforcing loop) (Sun *et al.*, 2014). Various combinations of reinforcing loops and balancing loops can be grouped into classic loop structures called systems archetypes (Wolstenholme, 2003). These archetypes can be identified in the complex system and each of them is associated with generic patterns of response and specific types of high leverage interventions that help to produce the desired results (Mella, 2012). The archetypes allow large complex systems to be reduced into simpler elements that can be dealt with in a systemic way.

The role of systems archetypes

Systems archetypes are generic structures (combination of balancing and reinforcing loops) derived from the fundamental structures that occur in various fields (Nguyen *et al.*, 2015a). They are useful for gaining insights into the "nature" of the underlying problem and for offering a basic structure or foundation upon which a model can be further developed and constructed (Braun, 2002). The ability to identify these archetypes allows one to more easily see places where there is leverage to solve difficult challenges and to find solutions to diverse types of problems, but yet having a common structure behind them.

System archetypes have multiple roles to play in systemic thinking (Nguyen *et al.*, 2013). They can provide a free-standing means by which to apply systems thinking by conveying to people that their plans for change will have side effects, and encouraging them to explore these. They also have a much wider role within the system dynamics modelling process. Archetypes have a role both at the front and back of the modelling process: up front, as a means of using their isomorphic properties as a way of starting the model conceptualisation activity by transferring insights from other models, and at the back, in ''collapsing'' down insights from models (Wolstenholme, 2003).

System archetypes play a vital role in export activities because the export firms and the import markets they are operate in are complex. Therefore, in this study, the systems archetypes have been identified to help understanding the reality of the factors and see the structures of these factors in the Vietnamese coffee supply chain.

- **Bayesian Belief Networks**

A Bayesian Belief Network is a type of decision support system based on probability theory which implements Bayes' rule of probability (Roventa *et al.*, 2009). This rule shows mathematically how existing beliefs can be modified with the input of new evidence (Neil *et al.*, 2001). It provides a framework for graphically representing the logical relationships between variables and capturing the uncertainty in the dependency between these variables using conditional probabilities (Henriksen *et al.*, 2008).

It is the basis for the popular inversion formula for belief updating from evidence (B) about a hypothesis (A) using probability measurements of the prior truth of the statement updated by posterior evidence

$$P(A|B) = (P(B|A) * P(A)) / P(B)$$

where A is the hypothesis, B is the evidence, and P(x|y) is the conditional probability of x given y.

It is derived by the use of the joint probability definition:

$$P(x, y) = P(x|y) * P(y) = P(y|x) * P(x)$$

that is then arranged as:

$$P(x|y) = P(y|x) * P(x) / P(y)$$

where x = A and y = B.

BBNs best met our modelling needs, particularly by providing a useful communication medium that clearly displays major influences on the coffee supply chain. For this reason the BBN modelling approach was selected to identify the systemic intervention strategies to increase the competitive advantages of the Vietnamese coffee product by testing different probable scenarios.

- **Approach**

System thinking was used in this study to develop a common understanding of the coffee manager's perceptions of the impacts of increasing the competitive advantages. It was also used as a mechanism for identifying potential leverage points within the system for increasing the competitive advantages through the analysis of different systems archetypes. To develop the 'map' (causal loop diagram) of the system under consideration, the study commenced with the *identification of relevant issues and variables* of the whole coffee supply chain. More than 60 representatives of different key stakeholders (producers, processors, agents and exporters as well as a number of experts) in the Vietnamese coffee industry attended the 'issue identification' workshops (conducted in the central highland of Vietnam) to identify the issues and challenges that they were facing .. During the workshops, a list of issues, potential solutions, drivers and barriers was identified from the perceptions and ideas of all the stakeholders (their different mental models). This list was evaluated, added to and refined during follow up group discussions. The experts selected and defined an initial hierarchical structure of the primary drivers of change in the whole coffee supply chain system, and, where their knowledge permitted, identified relationships (loops, feedbacks) between drivers in order to create the basis for the subsequent causal loop diagrams. A final causal loop diagram (CLD) for the whole coffee supply chain of Vietnam was created after detailed discussions, agreement and acceptance of the model by all the stakeholders that were involved. Common systems archetypes that provide a basis for developing a deeper understanding of the coffee supply chain system and to identify potential interventions to enhance the competitive advantages of the Vietnamese coffee product were also identified.

The final CLD was then converted into a BBN using NETICATM software (Corp, 2015) by indicating states for each variables and populating conditional probability tables (CPTs). The stages are probable conditions of variables in the real world. These were initially determined using the information obtained from the surveys, opinions of experts and researchers in the coffee sector. Almost all notes were assigned with binary states representing the most positive and negative expected levels. The CPTs were populated

using survey data. In cases where survey data were not available, expert opinions of probabilities for each state were used to populate the CPTs.

A follow-up workshop was conducted in the central highland of Vietnam with key representatives of different stakeholders in the coffee supply chain to review the BBN's structure. In this workshop, all the participants worked together to examine the graphical structure, names of the notes and states, and CPTs of the variables of the BBN. After finalizing the structure of the BBN and examining the probabilities, the participants were then asked to discuss and fill in the conditional probability tables (CPTs) of selected notes in the model that could not be populated with the survey data but for which they had expert experiential knowledge.

Finally, the BBN model was used to carry out simulation tests and scenario analyses to identify highly important factors influencing the competitive advantages in the whole coffee supply chain. Suitable interventions for these important factors were then suggested in order to enhance the competitive advantages of the Vietnamese coffee product.

RESULTS AND DISCUSSION

Using the systems thinking method, leverage points were identified analysing different systems archetypes derived from the complete causal loop model of coffee supply chain. Using BBN modelling, the sensitivity analysis was used to test the leverage points and define systemic intervention strategies that have the highest probability to enhance the competitive advantages of the Vietnamese coffee product.

The complete causal loop model and system archetypes

A causal loop diagram (CLD) helped the stakeholders to conceptualise the real world and understanding the patterns of behaviour and interactions between all the components of the system. In a CLD, the arrows indicate the direction of influence that connects different kinds of variables, and 'S' and 'O' signs were used to indicate the type of influence. The 'S' indicates that a pair of variables change in the same direction. An 'O' symbolizes that change is taking place in an opposite direction (Schaffernicht, 2010).

The complete causal loop model of the coffee supply chain consists of the interactions of three causal loop subsystems by way of common variables (coffee production sub-system, processing sub-system and exporting sub-system). It reveals the complex interdependence of many factors that influence the competitive advantages of coffee product in the supply chain (Figure 1).

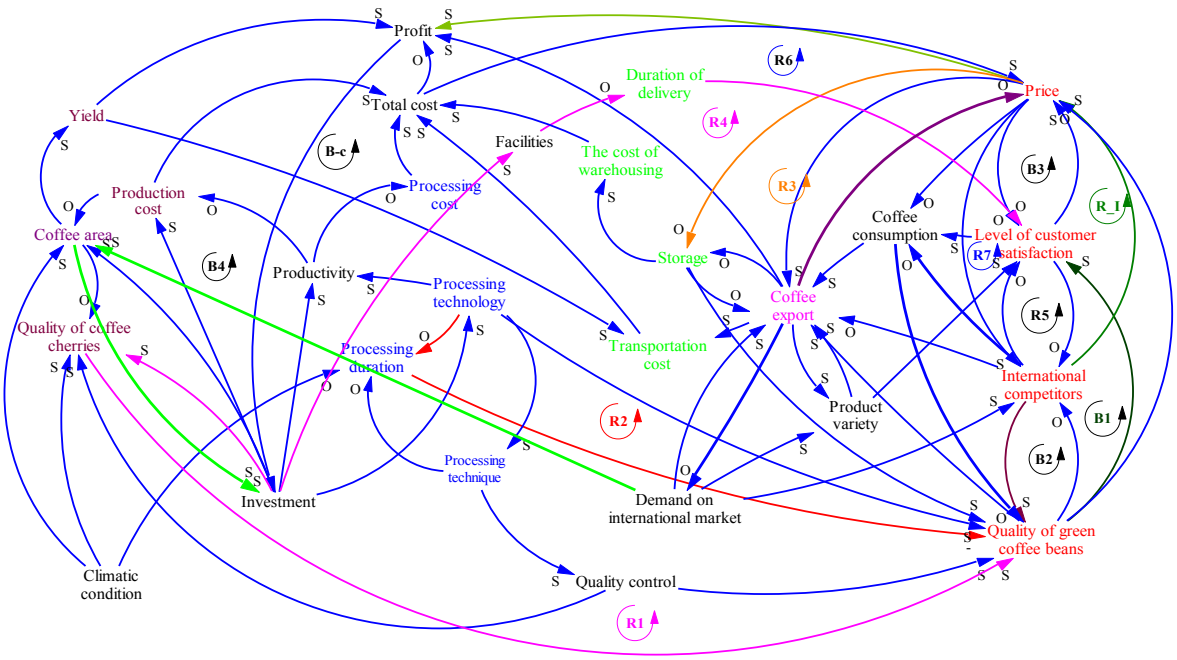

Fig. 1: The complete causal loop model of Vietnamese coffee supply chain (Source: Nguyen *et al., 2015)*

Analysis of the model helped to recognize the fundamental nature of the dynamics in the supply chain and potential interventions that could help to increase the competitiveness of Vietnamese coffee, this in particular involved comparing the scenarios to systems archetypes in the coffee supply chain. The analysis identified a series of interventions with potential leverage points to enhance the competitive advantages of Vietnamese coffee product in the global market.

Coffee price **(**Success to the successful**)**

> *"The Success to the Successful archetype describes the common practice of rewarding good performance with more resources in the expectation that performance will continue to improve. There is a belief that the successful have earned their increasing share of resources through past performance."*

Figure 2 depicts a 'success to the successful' systems archetype which consists of the key variables related to coffee export price. These include coffee demand, export volume, investment and quality of coffee products. Initially, an increase in price of coffee export in the international market will encourage increasing the investment in various components of the Vietnamese coffee supply chain, high investment in all supply members leads to an improvement in the quality of the coffee product. This in turn helps to further increase the price resulting in a reinforcing loop (R1). However, an increase in the price of coffee export will reduce the demand of coffee, consequently leading to a decrease in the export volume. A decrease in the coffee export volume means the decline of coffee supply in the market; this in turn increases the price (reinforcing R2). There is another factor that helps to support this structure, namely customer satisfaction. Customer satisfaction has a big effect on coffee price because it is the best indicator of how likely a customer will make a purchase in the future.

The key factor in maintaining price is to maintain the high quality of coffee in all the different stages of the supply chain. The best way to accomplish this is by investment in the quality of coffee seeds, the irrigation systems, the technique of cultivation and the quality of fertilizers for the production stage, sophisticates technologies for the processing stages, and in the warehouse facilities. However, this is

difficult for all components in the Vietnamese coffee chain because coffee products are mostly produced on a small scale, processed and warehoused in small enterprises where investment capital is always one of the challenges.

Another way to keep the price of coffee high is to control the supply of coffee in the market (the advantage of Vietnam being the second biggest coffee production and exporter in the world, therefore the coffee price in the market will be affected by Vietnamese coffee supply ability). to do this, the Vietnamese government would need to encourage the Vietnam coffee and cocoa association (VICOFA) to increase warehouse ability by issuing long term policy supporting capital, such as reduced interest rates for enterprises of VICOFA investment in warehouse facilities and buying the coffee product for warehousing.

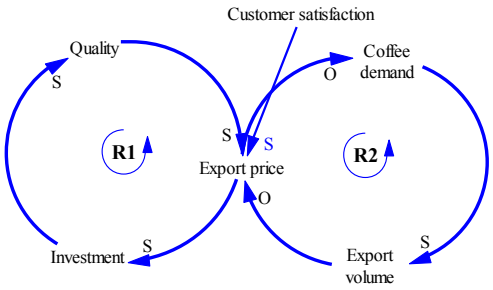

Fig. 2: Coffee export archetype

Coffee quality **(**Limits to growth/success**)**

> *"Archetype of limits to success consists of a reinforcing and a balancing loop as illustrated in Figure 3: a reinforcing loop that generates results and a balancing loop that slows down the results typically driven by a limiting condition (Senge, 1990)"*

The production stage has a major influence on the quality of coffee (Figure 3). An increase in the production scale leads to a decrease in the quality of coffee product because input materials such as seeds, technique, technology and management ability do not meet the needs of production (Nguyen *et al.*, 2015b). Therefore, this clearly proves that any investment to improve coffee production will contribute to better quality coffee cherries and consequently green coffee beans. A decrease in the quality of coffee also leads to a reduction in coffee export volume. A decrease in the volume of Vietnamese coffee export will cause coffee demand on the international market to increase, leading to a change in the same direction for scale of coffee production (see loop R, Figure 3).

The quality of coffee product is a main engine for increasing the level of customer satisfaction. Therefore, the number of competitor international Vietnamese coffee suppliers declines as a result of improved level of customer satisfaction. This clearly proves that any investment to improve coffee quality will contribute to reduce the number of coffee competitors and consequently increase consumption ability of coffee product. However, an increase in consumption in turn will reduce the quality of coffee product (see loop B, Figure 3). Thus, if Vietnamese coffee enterprises want to increase the volume of their coffee in international markets, they have to explore the variety of coffee markets. In order to meet the demands of different world markets, coffee enterprises have to adapt their coffee products according to desired tastes, and different quality standards for specific foreign market needs and wants (Nguyen *et al.*, 2015b). However, if variety in the quality of the product leads to a decrease in the quality of coffee because almost all Vietnamese coffee firms are small and medium, therefore, capital ability does not meet the needs of investment for maintaining coffee quality.

The loop shown in Figure 3 generally characterizes the dynamics that tend to constrain or suppress improvements in the quality of coffee. The common occurrence of the "limits to growth" archetype provides a basis for identifying high leverage interventions and actions that can be taken to improve the quality of green coffee beans.

There are a variety of ways to react when the quality of coffee declines. Often the first inclination is to invest more in the production stage or to upgrade technology in the processing stage. There is a potential difficulty with this solution because either the improved investment in the production stage via seeds and input materials or the upgrade of processing technology would require huge investments.

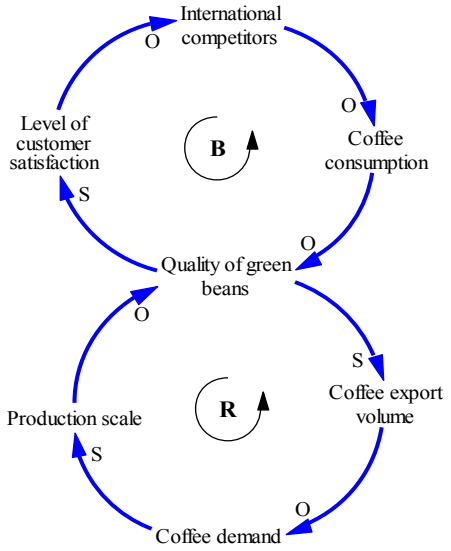

Fig. 3: Coffee quality archetype

Customer satisfaction **(**Fix that fail**)**

> *"The fixes that fail systems archetype is composed of one balancing loop and one reinforcing loop (Figure 4). It represents situations in which unintended and often harmful consequences follow well-intentioned actions. In such a situation, a problem (usually symptoms of a problem) appears which often requires immediate attention and 'quick fix' solutions from the relevant managers or decision makers. Although such quick fix solutions would normally ease the problem in the short term, they may create unintended consequences, which will make it much harder to cure the problem in the long term".*

This scenario describes how quality can influence customer satisfaction. The level of customer satisfaction is very strongly influenced by the quality of product. The improvement of quality reinforces itself through the level of customer satisfaction and pressure of investment. If the improvement of quality accelerates through investment, the level of customer satisfaction will be higher (see loop R, Figure 4). An increase in the level of customer satisfaction with the quality of coffee beans requires more investment; this will lead to a higher pressure on investment in all components in the supply chain which feeds back into further increasing the quality of product. However, when the level of customer satisfaction is high, the quality of the product is reduced (see loop B, Figure 4). This can be explained by the fact that when the quality of product is good enough, all components will be satisfied with their products. Therefore, the investment in technology for increasing quality will decline. Consequently, the quality of product declines.

Increasing the level of customer satisfaction is a difficult problem because it is constrained by quality, price and variety of product. There are two factors that help support an increase in the level of customer satisfaction – variety of product and quality goals. (1) In order to meet the demands of different world markets, coffee enterprises have to adapt and diversify their coffee products according to desired tastes, different quality standards and the variety in packaging for specific foreign market needs and wants. (2) Coffee enterprises need to establish quality goals. Goals can help all stakeholders in the supply chain stay focused, which can eliminate errors. Goals should be specific and measurable, such as size and shape of beans, or colour of beans, or percentage of black/broken beans.

The first intervention is a long term solution and commitment, it should be reflected in the stakeholders' vision and strategy in the coffee supply chain. The impact of such an intervention will probably not help those components in the supply chain which are currently experiencing the problem. However, although the investment is substantial, in the long term the leverage associated with this solution is also substantial.

The second intervention is also a long term solution and is not likely helpful in the short run. The success of this intervention also depends on the willingness and ability of the available managers to be mentors.

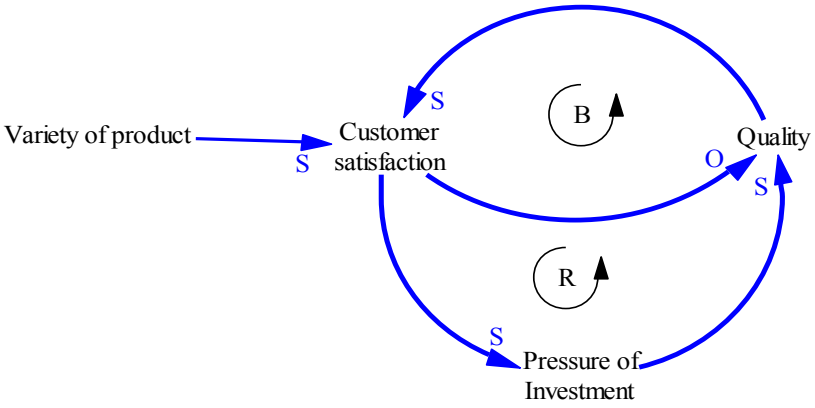

Fig. 4: Customer satisfaction archetype

International competitors **(**Tragedy of the Common)

> *"Tragedy of the Commons is composed of two reinforcing and two balancing loops (Figure 5). This archetype reveals that common sense behaviour can lead to destructive consequences over time (Maani and Cavana, 2007). In other words, individuals use a commonly available but limited resource solely on the basis of individual need. They are rewarded for using it at first; eventually, they get diminishing returns, which cause them to intensify their efforts. Eventually, the resource is either significantly depleted, eroded, or entirely consumed (Senge, 2006). This systems archetype is commonly seen in the use and management of natural resource and public goods.*

The number of competitors on the international market are directly related to the coffee export quality. The major variables involved in this scenario are investment, price, variety of product, and market demand (see Figure 5). The number of competitors is strongly influenced by the price and demand of the coffee product in the global market. Therefore, when price and demand of coffee product both increase, this will lead to an increase in the number of coffee suppliers in the market. However, increased the numbers of competitors tend to result in reduced coffee quality in the international market. This is due to the different conditions of providers in different coffee export countries. A decrease in the quality of coffee export leads to a reduction in the investment and tends to lessen the variety of products. In this

situation, the investment has positive impact on the price (see loop B1, Figure 5), and the variety of products has positive impact on coffee demand on the market (see loop B2, Figure 5). These factors (the price and the demand of coffee product in the market) then impact directly on the number of international competitors.

The most influential variable in this scenario is the price of coffee product. A possible intervention should result in a reduction in coffee export price. This is especially true in the area where the number of competitors has the largest impact on the competitive advantages of product. Some proposed ways to reduce Vietnamese coffee price are to (1) reduce the cost of all stages in the coffee supply chain, (2) increase productivity in main components (production, and processing) by considering effective investment in technologies, (3) maintain strong government support, and increase production efficiency by increasing management capacity in different stakeholders.

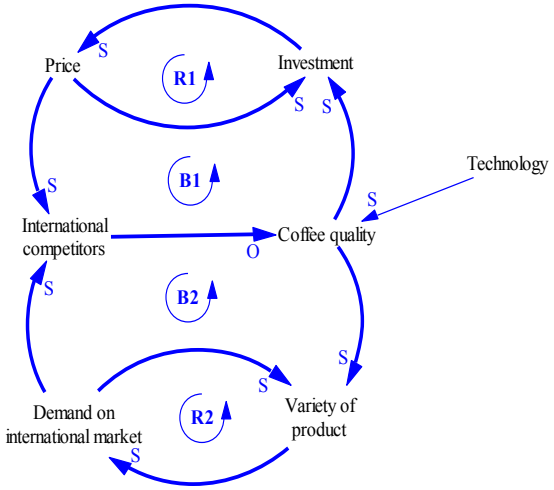

Fig. 5: International competitor archetype

To sum up, the analysis of systems archetypes in this section identified a series of leverage points and potential interventions to enhance the competitive advantages of Vietnamese coffee product.

Bayesian Belief Network Model and success factors for increasing the competitive advantages

BBN modelling was used to further test different scenarios to explore the potential factors that affect the competitive advantages of coffee product in the supply chain.

- ***Converting the complete causal loop model of coffee supply chain into an influence diagram***

The graphical diagram of a BBN is called an influence diagram or causal map; this is a directed acyclic graph consisting of nodes and links. The graph is acyclic, it cannot contain two-way arrows, cycles, or feedback loops (Bashari *et al.*, 2008). Figure 6 shows a part of influence diagrams of comprehensive Vietnamese coffee relating to the competitive advantages.

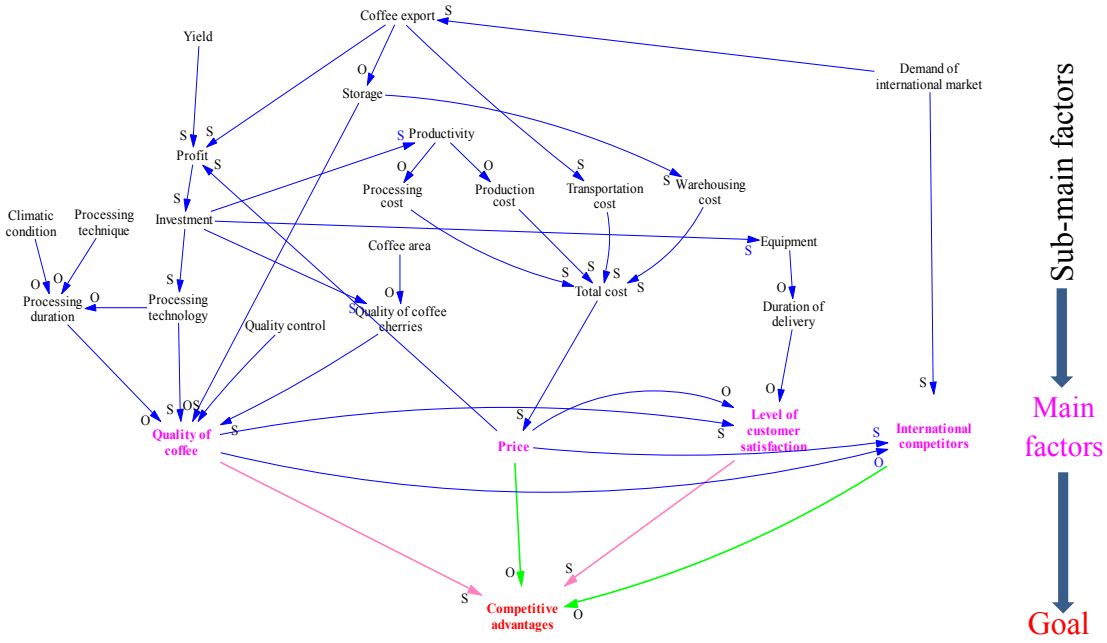

Fig. 6: Converting the complete causal loop model of the coffee supply chain into an influence diagram

A connection in influence diagram can be positive or negative (Nadkarni *et al.*, 2004). A positive connection indicates that an increase in the causal concept leads to an increase in the effect concept, whereas a negative connection indicates that an increase in the causal concept leads to a decrease in the effect concept. In Fig. 6, for example, 'Customer satisfaction' and 'Quality of coffee' exert a positive influence on the 'Competitive advantages.' Thus, the higher the level of customer satisfaction and better the quality, the higher will be the competitive advantages of the coffee product. On the other hand, 'Price' and 'International competitors' have a negative influence on 'Coffee's competitive advantages'. Thus, the higher price and competitors in the international market, the lower competitive advantages of Vietnamese coffee receives.

- ***Construction of the Bayesian Belief Network model***

The BBN model was constructed based on knowledge of Vietnamese coffee experts and prior analysis. The BBN was further tested under different scenarios by manipulating the influential variables at the second hierarchical level, which illuminates an important factor of using this method for increasing the competitive advantages of coffee product.

- *Scenarios (sensitivity) analysis*

Sensitivity analysis helped to identify the key determinants of the priority issues (Richards *et al.*, 2013). In the context of increasing the competitive advantages, sensitivity analysis was performed using the BBN to examine the important leverage variables within the identified system. The key nodes for enhancing the competitive advantages of coffee product include the quality, price, customer satisfaction and international competitors. Thus, different scenarios were developed according to the sensitivity analysis. In the baseline scenario (Fig. 7), the operational effectiveness BBN for the competitive advantages of coffee predicted that the probability of high competitive advantages is 52.5%. This can be attributed to the widespread product of high quality [p(*high*) = 54.8%], probability of low price [p(*low*) = 41.9%], probability of high customer satisfaction [p*(high*) = 52.3%], and probability of low international competitors [p(*low*) = 49.1%].

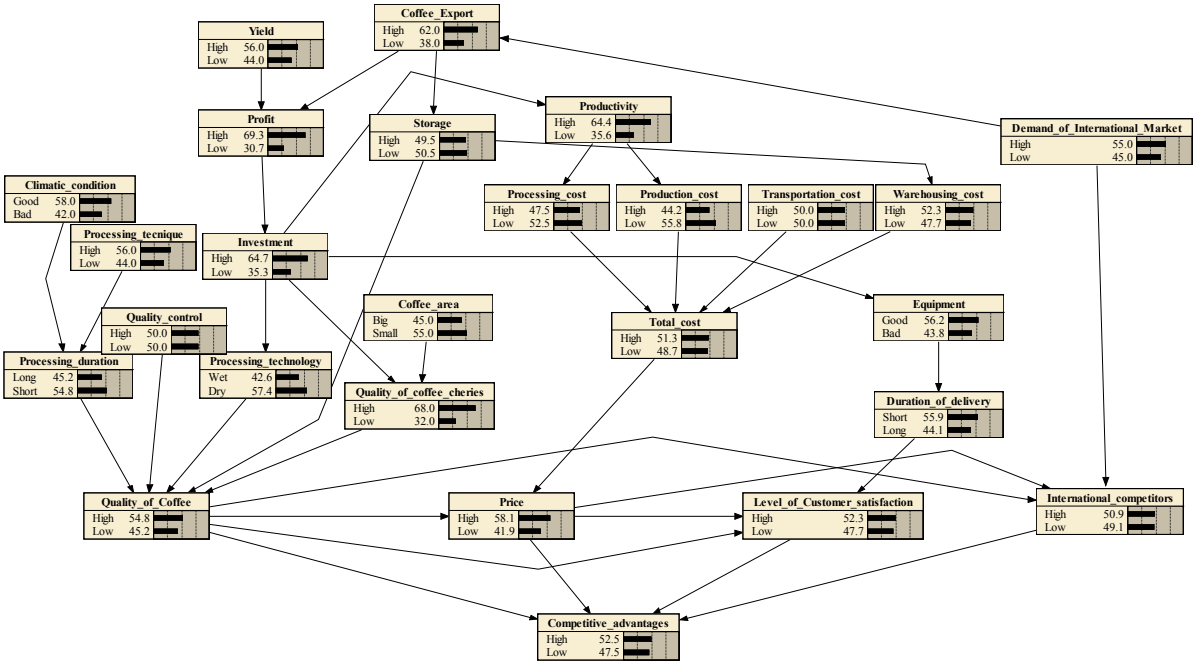

Fig. 7: BBN for enhancing the competitive advantages of coffee product showing the baseline scenario.

A sensitivity analysis of factors affecting directly the competitive advantages reveals that the level of customer satisfaction has the greatest influence, followed by the price and the number of international competitors with 4.8%, 2.9% and 1.8% respectively while the quality has the least influence with only 1.2% (see Table 1).

Table 1: Sensitivity analysis of competitive advantages to a finding at another node

Node	Entropy reduction
Level of customer satisfaction	0.04801
Price	0.02884
International competitor	0.01810
Quality of coffee	0.01285

Scenarios 1

In the first scenario, we considered increasing the level of customer satisfaction by changing the factors that impact directly on the level of customer satisfaction. The level of customer satisfaction is directly influenced by quality, price and duration of delivery. Among these influence factors, the quality of coffee product has greatest influence while the price of product has the least influence on the level of customer satisfaction (see Table 2). Intervention for enhancing the level of customer satisfaction therefore focuses on increasing the quality of coffee product.

Table 2: Sensitivity of level of customer satisfaction to a finding at another node

Node	Entropy reduction
Quality of coffee	0.04801
Duration of delivery	0.01181
Price	0.00005

A sensitivity analysis of the model showed that the most effective parameters for increasing the level of customer satisfaction were to increase the quality of coffee and reduce duration of delivery. Therefore, if the states of following variables in the map that impact on the factors influencing directly on the customer satisfaction are set up thus Processing duration=short; Quality control=high; Processing technology = wet; Quality of coffee cherries =high; Total cost = low; Equipment = good, the probability that a higher level of customer satisfaction will occur will rise from 52.3% (see Fig.7) to 67.1% (see Fig. 8). If the level of customer satisfaction increases, the probabilistic result will be that the competitive advantages will then also increases from 52.5 (see Fig.7) to 61.8 (see Fig. 8).

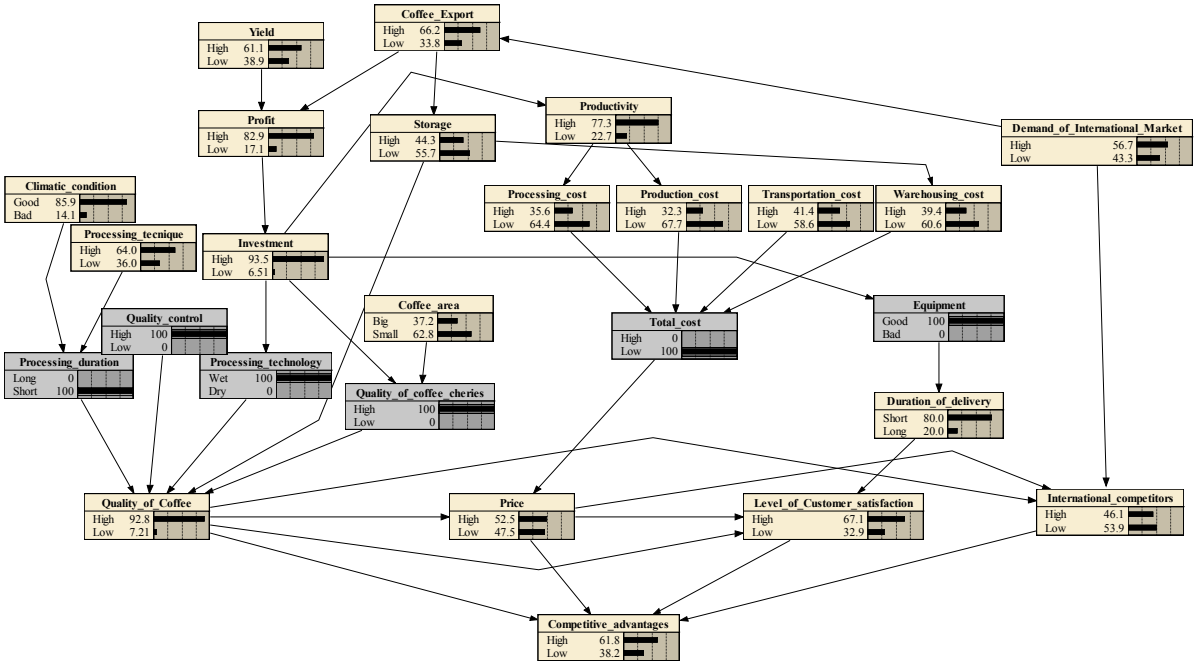

Fig. 8: BBN for enhancing the competitive advantages of coffee product showing the level of customer satisfaction scenario.

Scenarios 2

In this scenario, we considered how to reduce the total cost of coffee product effectively by changing influence factors. A sensitivity analysis of the model showed that the warehouse cost has greatest influence on the total cost with 4.75%, flowed by processing cost, production cost and transportation cost with 2.26%, 2.16% and 2.15% respectively (see Table 3). Therefore, warehouse cost should be considered as the key factor for intervention to reduce the total cost.

Table 3: Sensitivity of total cost to a finding at another node

Node	Entropy reduction
Warehousing cost	0.04746
Processing cost	0.02257
Production cost	0.02164
Transportation cost	0.02157

The scenario analysis presented in Fig. 9 shows that the conditional probability of total cost directly affecting the coffee price has the lowest value when the warehousing cost, processing cost, production cost and transportation cost are set up at 100% low. In this scenario, the probability (that is, a low price) increases from 41.9% (see Fig. 7) to 56.8% (see Fig. 9). This increase is attributed to the increase of the competitive advantages from 52.5% (see Fig.7) to 56.5% (see Fig. 9).

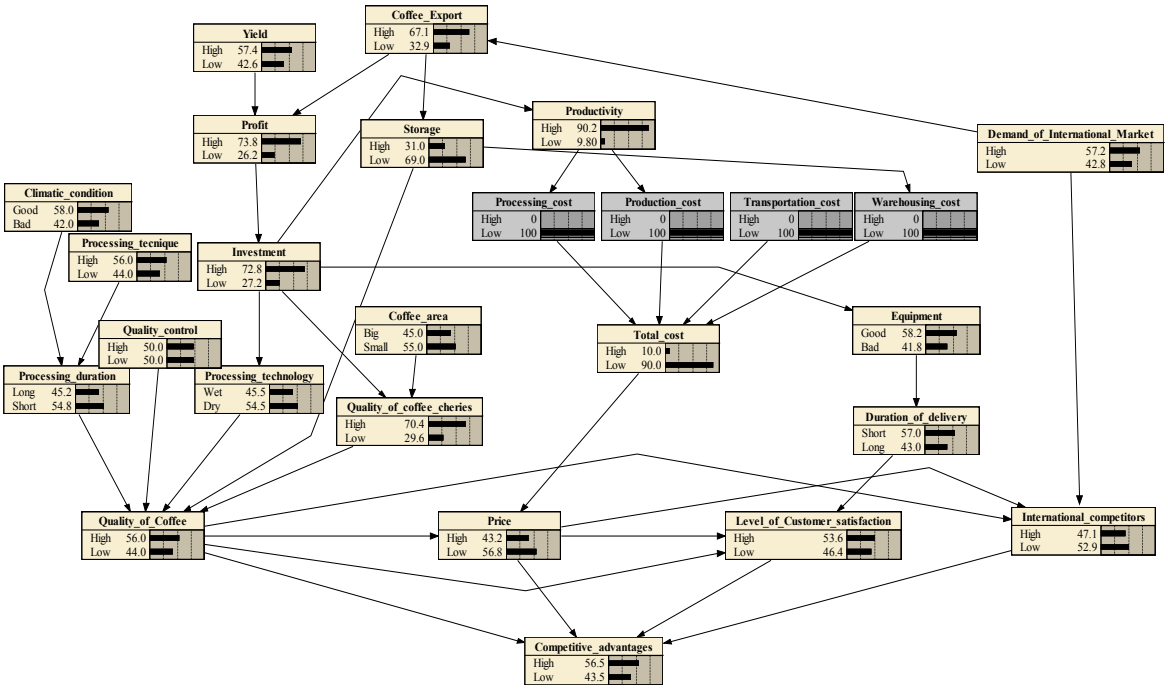

Fig. 9: BBN for enhancing the competitive advantages of coffee product showing the price scenario.

Scenarios 3

The number of international competitor is another factor that has an influence on the competitive advantages of Vietnamese coffee product. Thus, in this scenario we considered the number of competitors in the international market at the lowest level. A sensitivity analysis of the model revealed that among the influence factors, the demand for the coffee product in the international market has the greatest influence on the number of international competitors with 8.28%, followed by price and quality of coffee with 4.8% and 0.7% respectively (see Table 4). Intervention therefore focuses on reducing the demand of coffee in the international market.

Table 4*:* Sensitivity of international competitors to a finding at another node

Node	Entropy reduction
Demand of international market	0.08282
Price	0.04818
Quality of coffee	0.00070

The scenario analysis presented in Fig. 10 indicates that if selected nodes (long processing duration, low quality control, dry processing technology, low quality of coffee cherries, low total cost and low demand coffee in the international market) are set at 100%, the conditional probability of low number of the competitors in the international market increases from 49.1% (see Fig.7) to 71.9% (see Fig. 10). As a result of this the high competitive advantage also increases from 52.5 (see Fig.7) to 55.4% (see Fig. 10).

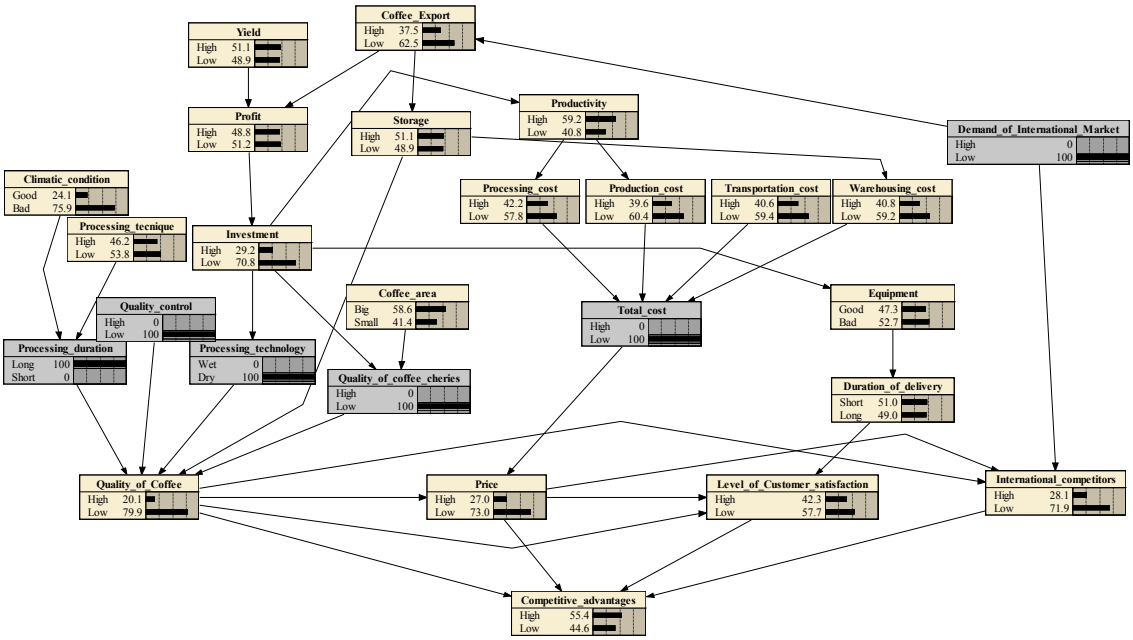

Fig. 10: BBN for enhancing the competitive advantages of coffee product showing the international competitor scenario.

Scenarios 4

In the fourth scenario, we considered increasing the quality of coffee product. A sensitivity analysis of the model revealed that the factors that have the most influence on the quality of coffee product are processing technology, processing duration, and quality control with 3.88%, 1.85% and 1.67% respectively (see Table 5). In contrast, the quality of coffee cherries and the storage situation have least influence with only 1.67% and 0.12% for each. Intervention therefore needs focusing on using wet processing technology and reducing the processing duration in order to enhancing the competitive advantages of coffee.

Table 5*:* Sensitivity of Coffee quality to a finding at another node

Node	Entropy reduction
Processing technology	0.03876
Processing duration	0.01848
Quality control	0.01674
Quality of coffee cherries	0.01654
Storage	0.00012

This scenario focuses on increasing the quality of coffee product. Accordingly, the states of the five variables that are dark colour in the map are specified as follows: Processing technology = wet, Processing duration = short, Quality control =high, Quality of coffee cherries =high and Storage= short. As shown in Fig. 11, the rate of coffee quality = high increases from 54.3% (see Fig.7) to 95%. The probabilistic result of the high competitive advantages under changing in this scenario then also increases from 52.5% (see Fig.7) to 57.8%.

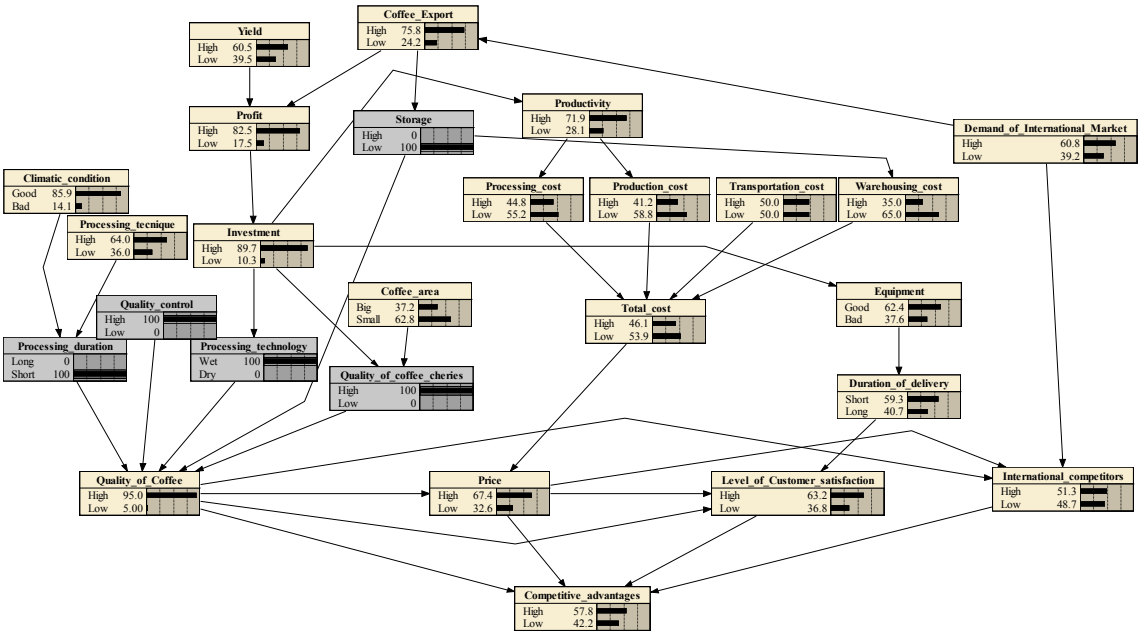

Fig. 11: BBN for enhancing the competitive advantages of coffee product showing the quality scenario

Intervention strategies for increasing the competitive advantages of Vietnamese coffee

The assessment of each of the four scenarios above provides a basis for the development of interventions for particular problems. However, each scenario is only part of the whole coffee supply chain story. Interventions in one part of the system will create effects in other parts of the system due to the interconnections between scenarios. The most effective interventions involve taking advantage of the feedback inherent in the system. In that way, a small, subtle intervention could have large impact due to the way the system amplifies some signals (Nguyen *et al.*, 2011). The key for selecting interventions is to identify points in the system with a high degree of connectivity. Also, exploit areas where the change will be accepted and the potential for compliance is high, and the good prospect for sustainable change exists. The coffee supply chain management model has four main leverage points in the system; the level of quality, price, customer satisfaction and the numbers of international suppliers (competitors) that sell products. Thus, interventions that influence these variables are likely to be amplified within the system.

- **Key issues and potential interventions**

The potential areas for intervention by both stakeholders participation in the workshops and sensitivity analysis revealed four main themes for enhancing the competitive advantages of Vietnamese coffee products, namely the level of customer satisfaction, price, international competitors and the quality of coffee beans.

In terms of customer satisfaction, a low level of customer satisfaction was identified by causal factors including low quality, high prices, and a long delivery time. Six interventions were suggested to overcome these problems: Firstly, reduce processing duration. Secondly, increase investment in wet processing technology. Thirdly, reduce duration of coffee storage for increasing the quality of coffee beans. Fourthly, reduce the total cost that impacts directly on the price by increasing the productivity. Fifthly, reduce the volume of coffee storage. Finally reduce the duration of delivery via upgrade distribution systems to customers (such as infrastructures and facilities, means of transportation and inventory).

In terms of the price, a high price identified causal factors including a high total cost, and a high quality of coffee products. However, the quality of the product is a vital factor for not only increasing the level of customer satisfaction but also reducing the number of international competitors of Vietnamese coffee products in the international markets. Therefore, increased productivity in both production and processing by increasing investment, transportation cost reduction and volume reduction of coffee storage were found to be the main intervention points for reducing the total cost in the entire coffee chain.

In terms of the numbers of international competitors, the quality, price of coffee product and the demand for the coffee in international markets are the main intervention points for reducing the numbers of international competitors. The BBN simulation (see Table 4) shows that the demand for coffee in the international markets was found to have large impact on the number of competitors. However, detailed discussion at the workshop revealed that if the demand for the coffee in the world reduces, then the Vietnamese coffee export volume also decreases. This has a negative impact on profits (what is an important factor for increasing investment of all elements in the coffee supply chain) and the volume of coffee storage in the whole coffee chain. Therefore, the interventions should focus on increasing the quality and reducing the price of coffee products within the global market.

Increasing investment, improving quality control, reducing processing duration and also reducing the volume of coffee storage are four highly important interventions for improving the quality of coffee. Any investment to improve coffee production and processing technology will contribute to better coffee quality. According to the participants, this is a potential problem because it would require huge investments while almost all Vietnamese coffee firms are small and medium sized. Therefore, funding need to be provided to coffee firms by the state bank, commercial banks and international financial organizations.

- **Implementing interventions**

With the interventions outline in the key issues and potential interventions section above, a modified version of the competitive advantages assessment model was developed by the researchers (see Fig. 12). Simulation tests using the model illustrate that processing duration, quality control, investment, storages, productivity and transportation costs are key interventions that could increase the competitive advantages for the Vietnamese coffee products. More importantly, the investment factor plays a vital role in changing the competitive advantage factor because it influences not only the quality but also the price of product as well as profits for all the elements in the coffee supply chain.

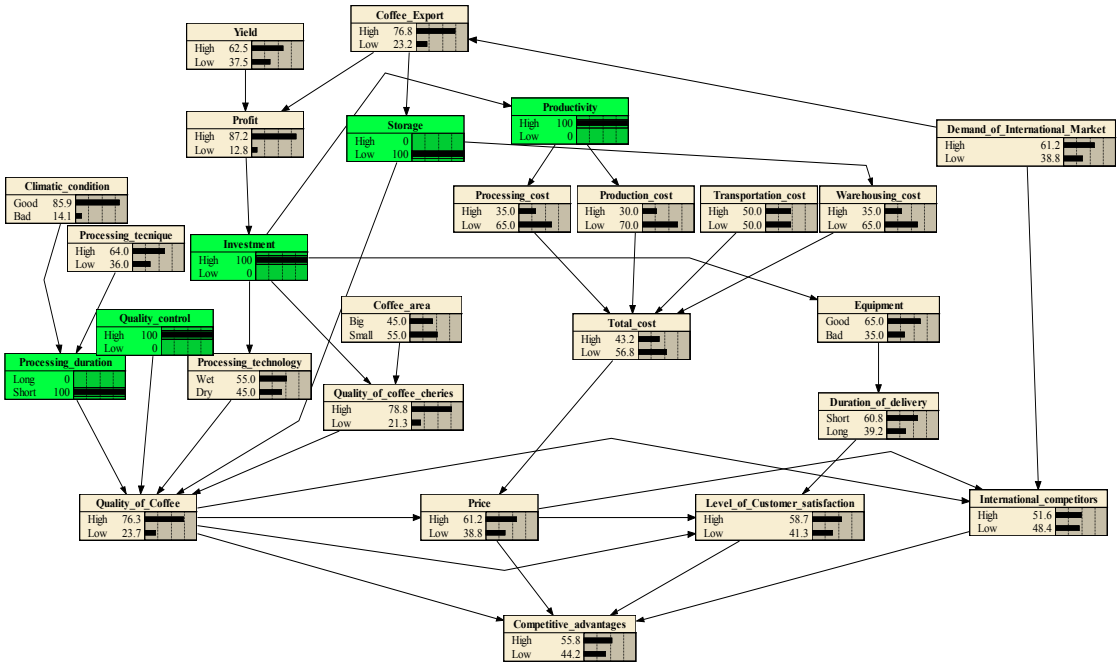

Fig. 12: BBN for enhancing the competitive advantages of coffee product showing implementing interventions.

A comparison of prior (see Fig. 7) and posterior marginal (see Fig. 12) of the competitive advantages, and other important factors namely quality and price of product, level of customer satisfaction, number of international competitors, profit of all elements in the coffee chain and volume of coffee export is shown in Table 6.

Table 6: Prior and posterior marginal probabilities under implementing interventions

	Nodes	Prior marginal probability	Posterior marginal probability	Change (% probability)
1.	**The competitive advantages** (High)	52.5	55.8	3.3
2.	**Quality** (High)	54.8	76.3	21.5
3.	**Price** (Low)	41.9	38.8	(3.1)
4.	**Level of customer satisfaction** (High)	52.3	58.7	6.4
5.	**International competitors** (Low)	49.1	48.4	(0.7)
6.	**Profit** (High)	69.3	87.2	17.9
7.	**Volume of coffee export** (High)	62.0	76.8	14.8

In this intervention, the posterior probabilities of the competitive advantages = high increases from 0.525 to 0.558, that of profit =high increases from 0.693 to 0.872 and that of volume of coffee export = high increases from 0.62 to 0.768. The intervention results not only increases the competitive advantages of Vietnamese coffee within global markets but also increases the profit in all elements of the Vietnamese coffee supply chain.

CONCLUSION

The goal of this study is to enhance the competitive advantages of Vietnamese coffee products by identifying and intervening in the leverage points within the complex coffee supply chain system. A combination of systems thinking and BBN modelling was used to find the most important factors that impact on the competitive advantages of coffee products in the supply chain.
Firstly, system thinking was used to develop complete causal loop diagrams of the coffee supply chain and it also helped to identify the leverage points through the use of systems archetypes.

Secondly, the BBN model was developed in the assessment framework for the multiple factors influencing the competitive advantages of coffee products. Sensitivity analysis was used to identify key parameters or key interventions that need to be determined accurately for all relevant stakeholders in the coffee supply chain.

Thirdly, interventions in the key factors were suggested to enhance the competitive advantages of coffee. The findings show that the investment in all elements of supply chain can be considered as the highest leverage point for intervention to increase the competitive advantages of Vietnamese coffee.

This study recommends that these interventions should be developed or adapted into appropriate management strategies by taking the findings back to stakeholder groups for further consideration and adjustments as part of a learning process rather than simply an exercise in model building.

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CHAPTER 7

CONCLUSIONS AND FUTURE RESEARCH

7.1. Research implications

Supply chain management (SCM) has become a potentially valuable way to increase the competitive advantages of a product (Li *et al.*, 2006a; Scott *et al.*, 1991). Recently, some organizations have realized the importance of implementing supply chain management to enhancing their competitive advantages (Li *et al.*, 2006a; Mason-Jones *et al.*, 1997);however they often do not know exactly what to implement, due to a lack of understanding of what constitutes the comprehensive set of supply chain management factors and components (Stewart, 1995). In this study, it provides insights into the measures that could play a key role in improving the competitiveness of Vietnamese coffee by proposing a developing causal loop diagram, validating a model to identify potential leverage points. It also provides supply chain management managers with a useful tool for evaluating the comprehensiveness of their current coffee supply chain management practice by finding the systemic intervention strategies of the construct of coffee supply chain management and demonstrating its efficacy in enhancing the competitive advantage. This study has shown that supply chain management directly impacts on the price, quality, customer satisfaction and competitors of coffee product which are four major aspects of competitive advantages. The findings of this research, therefore, point to the factors that impact on these four major aspects for enhancing the competitive advantages via identifying potential factors in different supply members of the Vietnamese coffee supply chain.

Today's competition is moving from “among organizations” to “between supply chains” (Li *et al.*, 2006a; Nishat Faisal *et al.*, 2006); more and more organizations and countries are increasingly accepting the role of supply chain management in the hope of increasing the competitive advantage (Markley *et al.*, 2007; Tan *et al.*, 1998). The findings of this research support the view that supply chain management can have an evident impact on the competitive advantages. It should be noted that the competitive advantages of Vietnamese coffee may be influenced by contextual factors in the supply chain, such as the type of coffee processing and coffee firm size. For example, the up-to-date processing technology, measured by the quality of coffee beans, may be higher for larger companies since they often have enough capital investment available for better technology. Moreover, the larger organizations may have higher levels of customer satisfaction since they have the ability to increase their investment in processing technology. This means that bigger quantities of the coffee cherries will be processed through advanced technology. By doing this, the duration of the processing stage will be reduced, leading to an increase in the quality of coffee beans. When this occurs, the level of customer satisfaction (coffee roasters or coffee exporters who consume green coffee beans) will also be higher (Nguyen *et al.*, 2015).

7.2. Conclusion

This research set out to identify potential factors to increase the competitive advantages of Vietnamese coffee product by implementing systems thinking methodology as an effective approach to managing supply chains in a dynamic environment. This study provides empirical evidence to support conceptual and prescriptive statements in the literature regarding the system thinking approach in supply chain management in order to increase the competitive advantages of coffee product. It solves the problem of

enhancing the competitive advantages by using a system thinking approach, while previous research efforts have not addressed this problem. The system thinking approach helps to improve the quality, reduce production cost, and increase the level of customer satisfaction across the entire supply chain in a systemic way, through managing complex relationships among coffee supply members, and identifying leverage points in these relationships. From a systems approach, it is feasible to get a holistic view of the complex relationships between supply members, where the causal loop diagram becomes too complicated because of the difference of supply members. The systems approach offers at least three important theoretical contributions to solve the competitive advantage problems and provides a good insight for further work.

First, it provides causal loop diagrams of different stakeholders in the coffee chain, which serve as a simple visual representation of the complex relationships between key variables in the different states of Vietnamese coffee supply chain. These causal loop diagrams can be used to identify potential leverage points for interventions in enhancing all four aspects of the competitive advantages, namely the level of customer satisfaction, the quality of the product, the degree of competition experienced, and the price of the product in all stake holders of the chain from producers to exporters. They are also used to identify potential strong leverage points for intervention to increase the competitive advantages for each stakeholder.

Second, development of a general causal loop diagram for the whole coffee supply chain in this study is a new extension of the coffee supply chain model. A causal loop diagram in supply chain management has been proven to be one of the most powerful tools for organizations to achieve a competitive advantage in the global market. It can help

managers to classify the roles of stakeholders, identify the key capabilities to structure each collaborative relationship, and evaluate the stakeholders' readiness to collaborate. In addition, it provides critical information which would help managers of supply chains to better grasp the main facets of supply chain management and take the right actions to enhance the overall competitive advantages. Hence, it is a useful tool for speeding up new insights into ways of enhancement of competitive advantages in dynamic supply chain decision-making environments through identifying the leverage points.

Third, system archetypes and Bayesian Belief Networks (BBNs) methods can serve as useful modelling tools in analysing coupled improvement problems. The systems archetypes have been identified to help understand the reality of the factors and see the structures of these factors in the Vietnamese coffee supply chain. The ability to identify these archetypes makes it easier to see places where there is leverage to solve difficult challenges and to find solutions to diverse types of problems while still maintaining a common structure behind them. The Bayesian Belief Network (BBN) model, provides a framework for graphically representing the logical relationships between variables and capturing the uncertainty in the dependencies between these variables using conditional probabilities. The BBN has been tested (chapter 6) under different scenarios by manipulating the influential variables at the second hierarchical level, which indicates important factors by using this method for increasing the competitive advantages of the coffee product. Sensitivity analysis was used to identify key parameters or key interventions that need to be determined accurately for all relevant stakeholders in the coffee supply chain. The key nodes for enhancing the competitive advantages of coffee product include the quality, price, customer satisfaction and international competitors.

7.3. Limitations to consider in future research

This study attempted to increase the efficiency of supply chain management, in order to provide useful insights to managers seeking to improve the competitive advantages of coffee products. Supply chain management is complex and involves a network of companies in the task of producing and delivering a final product, so its entire domain cannot be covered in just one study. Therefore, this study, like others, has limitations and unsolved issues.

First, if the business environment is changing drastically and frequently, mutually dependent relationships of the quality, cost, customer satisfaction, and the number of international competitors may change dramatically and influence the competitive advantages. Hence, the business environment factors that influence the supply chain management should be solved. This problem should be investigated in future research to aimed at achieving the competitive advantage goals.

Secondly, the systems thinking approach was very useful to help supply chain managers to identify the critical success factors they should focus on in order to enhance the competitiveness of the product. However, one weakness of this approach is that, in some cases it draws results based on perceptions which are not exactly representative of the real world. Therefore, future studies should examine the proposed relationships by bringing some contextual variables into the model.

Thirdly, as the concept of supply chain management is complex and involves a network of stakeholders in the effort of producing and delivering a final product, its entire domain cannot be covered in just one study. Thus, future research can expand the domain of supply chain management practice by considering additional dimensions such as

geographical proximity, cross-functional coordination, logistics integration, and agreed supply chain leadership, which have been ignored in this study.

This study increased our understanding of supply chain management strategies to enhance the competitive advantages of coffee products and resulted in some general conclusions concerning strategic congruence, but at the same time it identified multiple further research ideas.

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