An Appraisal of Vendor Managed Inventory Strategy in Mining Operations, the Case of Gold Fields Ghana Ltd.

BY

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CERTIFICATION

I hereby certify that this submission is my own work towards the Master of Business in Administration program and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the university, except where due acknowledgement has been made in the text.

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DEDICATION

This work is dedicated to my three wonderful children, Egbert, Caleb and Kingston.

ABSTRACT

Gold Fields Limited is one of the world's largest un-hedged producers of gold, providing investors with maximum leverage to the gold price. In order to achieve it mission of "achieving outstanding returns for investors....."Gold Fields must improve the current business processes by establishing long term relationships with their major suppliers. Today, GGL faces a high level of inventory, which has resulted substantial amount of tied up capital and inefficient processes. Therefore, this study will evaluate the effects that a vendor managed inventory (VMI) partnership has had on GGL's and two chosen suppliers.

VMI is a concept within supply chain management, where the supplier is fully responsible for managing the customer's inventory level. To achieve this, the supplier is given access to sensitive information of the customer's inventory level and demand and can, thereby, replenish the customer's stock when needed. Although, some firms have embraced the concept with success, others have retreated forcefully.

This study has conducted a broad literature review regarding VMI and performance measurements, as well as, organisational structures and information sharing in collaborative partnerships. In addition to the thorough study of GGL's processes, field visits were made at the suppliers' to visualize their material and information flow in order to examine what areas VMI have had an impact.

The conclusion of this study is that a VMI strategy, in supplement with a consignment stock policy, is very effective for GGL. Further, the study indicates that there are mutual benefits from a VMI implementation for both the customer and the supplier. Specifically, a higher service level from the suppliers has been attained by GGL, while the suppliers have also obtained improvements within the areas of inventory and order processing. However, there is still more room for improvement. It is advised that for efficient operations and maximization of benefits of VMI to all the actors; the following principles should be adhered to:

- Communicate expectations of all parties.
- Precise information must be shared

- Reliable transmission, receipt, and use of information must be ensured
- Expect implementation to be a process not a project
- Plan to spend sufficient time and money to make it work.

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To all my group members, I appreciate your brotherly love care and support. To you all I say thank you.

To my Church members I say thank you very much for your, prayers and support, special thanks goes to Ps Roland Owusu Ansah for his encouragement.

Special thanks also go to my wife; Mrs. Mercy Djan, whose love and encouragement have seen me through. I say thank you for your patience and tolerance and your support throughout my two year program and during this work too. Thank you, Egbert and Caleb, for your understanding anytime I had to leave for school. Thank you for your love and cooperation during my study, may the Lord favour you all.

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CHAPTER ONE

GENERAL INTRODUCTION

1.1 BACKGROUND

There has been considerable interest in recent years among practitioners and researchers regarding how to make the dream of an integrated supply chain a reality. The idea of the entire supply chain acting in a coordinated, synchronous fashion to achieve higher levels of customer service for end customers at a lower total supply chain cost is inherently attractive. The desired outcomes not only enhance customer loyalty and margins, but also ensure the very survival of the firm and its supply chain partners in increasingly competitive markets. (Pohlen and Goldsby; 2003)

Wikner et al (1991) also attested that removing an echelon in a supply chain can be of great benefit in improving dynamic performance. This is because there is potential for a two-fold improvement. Firstly, due to elimination of delays in both information and material flow and secondly, a decision-making activity that customarily increases distortion in the order waveform as it flows upstream is eliminated. Vendor managed inventory (VMI) is one practical way of seeking to obtain the benefits of echelon elimination. (Towill and del Vecchio, 1994)

VMI is a supply chain strategy whereby the vendor or supplier is given the responsibility of managing the customer's stock. (Disney and Towill, 2003). Pohlen and Goldsby (2003) also defined VMI as; "VMI involves the coordinated management of finished goods inventories outbound from a manufacturer, distributor or reseller to a retailer or other merchandiser".

1.2 PROBLEM STATEMENT

Vendor managed inventory (VMI), also known as continuous replenishment or supplier-managed inventory, is one of the most widely discussed partnering initiatives for encouraging collaboration and information sharing among trading partners. Could this be due to the benefits derived form such strategic approach? How does the implementation of VMI add value to the operations of mining companies? What parameters ensure a smooth implementation of VMI? Is the vendor or supplier's capacity to manage the inventory a factor

to consider? What is the role of information flow in the implementation of VMI? What kind of product is suitable for VMI implementation? These are but few of the questions that this research seeks answers

1.3 RESEARCH OBJECTIVES

a) To critically examine the benefits of VMI in the operation of Goldfields Ghana Limited, Tarkwa mine within the framework of Economic Value Addition (EVA).
b) To examine the setbacks faced by VMI and to prescribe ways to mitigate its impact and;
c) Prescribe ways to improve upon the operations of VMI in the mining sector.

1.4 SIGNIFICANCE OF THE STUDY

This study is motivated by the current trends in supply chain management. In today's highly competitive environment, many companies are aiming to gain a share of the global market and to take advantage of higher production and sourcing efficiencies. A key determinant of business performance nowadays is the role of the "logistics function" in ensuring the smooth flow of materials, products and information throughout a company's supply chain at minimal cost. Daugherty et al, (1995); also attested to the fact that more recently, logistics has become more prominent and is recognized as a critical factor in achieving competitive advantage. The overall objectives behind it are to:

- reduce operating costs;
- meet demand fluctuations; and
- reduce capital investment.

The general problems that arise in corporate logistics include delayed and inaccurate information, incomplete services, slow and inefficient operations, and a high product damage rate. The possible consequences are an inability to provide inter-linked services, high operating costs, a high rate of inaccuracy, and a lack of flexibility in responding to changing demand requirements. This project will try to provide answers to the above general problems in corporate logistics and further brings to light the benefits that one stands to gain in VMI implementation which invariably will serve as a bench mark for allied industries. This research will also bring to bear the parameters within which the implementation of VMI is

appropriate. Finally this research will outline methods by which the VMI implementation can be improved.

1.5 LIMITATION

This research is limited to the operations of Goldfields Ghana Limited, Tarkwa and only two of its vendors, Mesto Minerals and Sandvik Mining and Construction. It is also limited to the value addition of VMI to the operations of both the user (Goldfields Ghana Limited, Tarkwa) and the selected vendors (Mesto Minerals and Sandvik Mining and Construction). The qualitative method has been extensively employed in this research.

1.6 ORGANISATION OF THE STUDY

This work is made up of six chapters. Beginning with chapter one, it introduces readers to the motive behind the study. This chapter is made up of Background to the Study, Statement of the Problem, Research Questions, Significance of the Study, The Purpose of the Study, and Limitations to the study. Chapter two provides brief profiles of the companies involved in the VMI partnership. Chapter three deals with the review of related literature, which is both theoretical and empirical. Chapter four describes the methodology used for the study, it also deals with detailed discusion of subjects, procedures and data analysis procedures. Chapter five deals with findings, analysis and presentation. And chapter six consists of the summary, conclusions and recommendations.

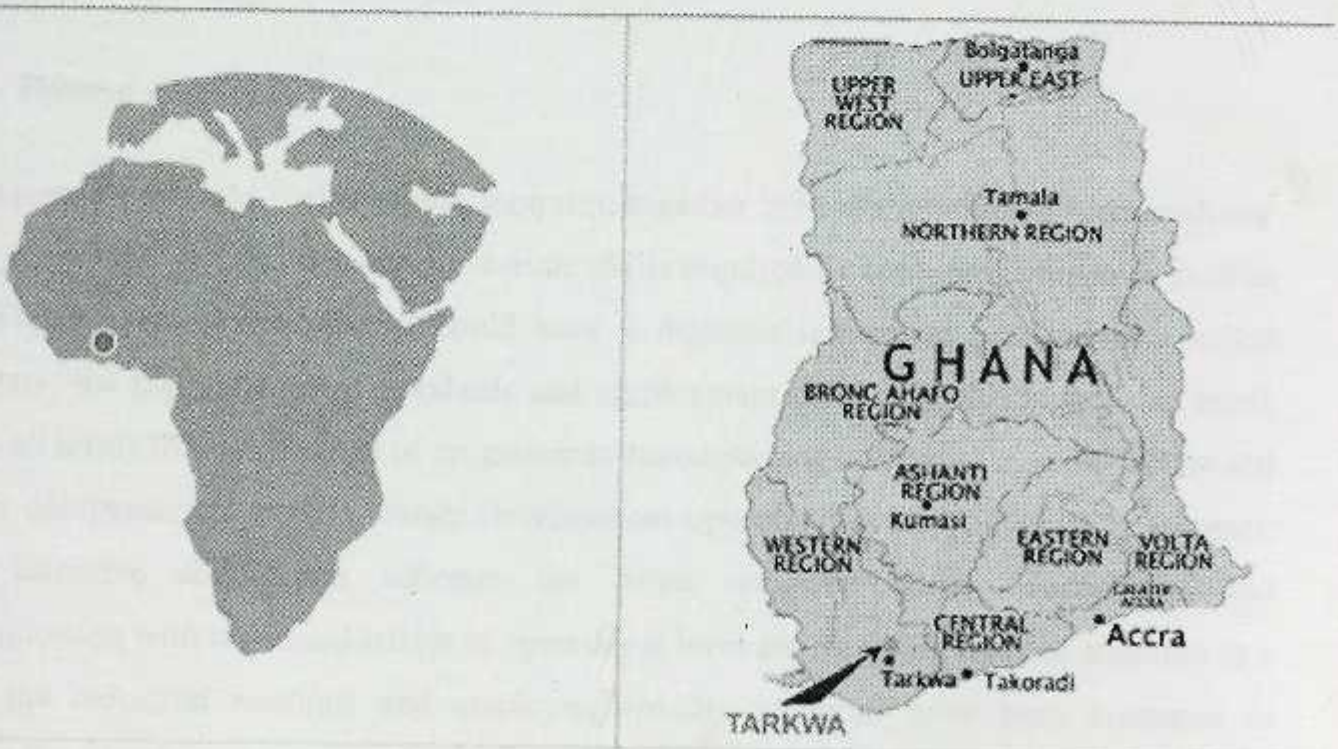
CHAPTER TWO

COMPANY PROFILES

2.1 Introduction

This chapter introduces Gold Fields Ghana Ltd. Metso Minerals and Sandvik Mining and Construction Ghana. All three companies though multi nationals have offices in Tarkwa, a mining town in the western region of Ghana as shown in the maps below.

Fig. 2.1 Location of the Gold Fields Tarkwa Mine



2.2 Gold Fields Limited - The Complete Gold Company

Gold Fields Limited is one of the world's largest un-hedged producer of gold, providing investors with maximum leverage to the gold price.

Gold Fields has an attributable production of 4.0 million ounces per annum, mineral reserves of 94 million ounces and mineral resources of 252 million ounces. The Group employs some 47,000 permanent employees across its operations and is listed on the Johannesburg Stock Exchange (JSE) Limited, South Africa (primary listing), the New York Stock Exchange

(NYSE) as well as the Dubai International Financial Exchange (DIFX). (www.goldfield.co.za)

Vision

The vision of Goldfields is to be a leading, globally diversified, precious metals producer through a responsible, sustainable and innovative development of quality assets.

Mission

Gold Fields is intent on achieving outstanding returns for investors with motivated employees committed to optimising existing operations and aggressively pursuing and developing additional world-class deposits, promoting mutually beneficial relationships and applying best practice technology.

2.2.1 Human resources

The expansion of Gold Fields global footprint, together with the continuing 'commodities' boom', continues to raise demand for certain skills required by resource companies such as Gold Fields to the extent that it could have a negative impact on productivity, project continuity, the maintenance of standards and employment costs. Goldfields seeks to retain staff at all levels through a range of programmes encompassing competitive, tax-effective and flexible compensation models, career development opportunities and mentorship schemes. Share incentive and bonus schemes are being reviewed while relationships and communication with organised labour at operational level are receiving focused attention as a result; the industrial relations and employee benefits functions have been separated to improve the situation.

2.2.2 Political Issues

Mining operations are physically bound to the location of their orebody. As a result, the sector is exposed to unexpected changes in national regulatory requirements, such as the tax regime, the terms of royalty agreements, as well as levy and license conditions. Such uncertainties can have a material effect on overall profitability and influence investment decisions in certain regions where there is political volatility, a divisive electoral process or a drift towards undemocratic rule. In addition, there are local, national and international campaigns against mining activities and specific forms of mining, all of which have the potential to influence public perceptions of the industry. These could include demands from

labour and other social demands. Gold Fields remains particularly conscious of these dynamics and continues to develop relationships and mutually beneficial partnerships with all levels of government and non-governmental stakeholders in each country of operation..

2.2.3 Ore reserves

Gold Field's operations confront a range of uncertainties when estimating ore reserves and delivering forecast grades due to the inherent risky nature of mining. As new information or technology becomes available, reserve estimates may change significantly over time and product price or currency fluctuations may cause lower ore grades to significantly affect its economic viability. Any significant restatement in the ore reserve may impact on the company's profitability and cash flow over time. To manage this risk, Gold Fields maintains access to world-class in-house and external geological, mineral and resource management capacity.

This capacity has expanded over time to take account of the increasingly diverse orebodies the company exploits, with highly experienced staff familiar with diverse geological settings constantly monitoring pertinent geological assumption changes.

2.2.4 Health, Environmental and social

As its global footprint expands, Gold Fields is subject to an ever-growing range of national environmental laws, regulations and permit conditions as well as a more active stance by global and local environmentally focused organisations and community groups. Continued compliance with evolving regulatory requirements and dynamic community expectations holds the potential for increased costs and/or potential litigation that could impact negatively on cash flow and earnings. Gold Fields' response to these risks is to resource its environmental and community engagement structures adequately at an operational and corporate level so as to enable it to operate within the law. Through the implementation of the AA 1000 stakeholder engagement system, the Group builds and maintains inclusive, constructive, long-term relationships with its stakeholder communities. In addition, the company environmental management system has since 2003 been certified to the international ISO 14001:2004 standard by external auditors. The Group also seeks to integrate its community engagement more closely with environmental management functions, making both more sustainable through increased integration. Thus, many rehabilitation

efforts are simultaneously aimed at creating, inter alia, sustainable livelihoods, while energy efficiency projects are also assessed for the carbon footprint reduction.

In addition, the industry confronts various regional, non-occupational healthcare challenges, such as the HIV/AIDS pandemic, which is particularly severe in southern Africa, and Malaria, which is prevalent in West Africa. Left unmanaged, such medical challenges could adversely affect productivity, safety, general medical costs and absenteeism. Both have been aggressively targeted with a strong emphasis on employee and community involvement and prevention through a variety of educational initiatives. In addition, a preventative employee wellness programme for all employees is in place, which is complemented by a multi-tier HIV/AIDS management programme for those affected by the disease.

2.2.5 Financial

Like all gold producers, Gold Fields is subject to the volatility of the gold price and exchange rates. This volatility could adversely impact on the Group's earnings, assets and cash flows. Marginal operations and long-term investment decisions relating to mine-deepening projects are particularly impacted by such fluctuations. Rising commodity input costs and sourcing bottlenecks driven by strong global demand for diesel, timber, tyres and certain chemicals have also impacted on production costs and could continue to do so in future. Gold Fields' response to these volatilities continues with the pursuit of Project 500, which comprises both projects aimed at generating additional revenues through enhanced productivity and better grade selection aimed at improving quality volumes (Project 400) and initiatives designed to achieve considerable savings (Project 100, Project 100+ and Project Beyond). Capital projects, such as the mine-deepening projects, are structured on a modular basis to allow for the suspension of the project should market conditions change which could adversely affect the feasibility of the project. At the same time, these projects are designed not to adversely affect the Group's adherence to, and compliance with regulation, industry standards and adopted voluntary codes. Gold Fields believes the way to sustain healthy margins and buffer real inflation pressures is through effective cost management and investment in continued margin optimisation initiatives. As a result Gold Fields continues to drive various initiatives through its global integrated supply chain and strategic sourcing optimisation programme which seeks to reduce procurement costs through centralised buying, standardised usage of inputs and better inventory management (www.goldfield.co.za). Where appropriate, the Group also seeks longer term, mutually beneficial arrangements with suppliers and

technology partners. The Group also takes an active role in strengthening global demand for, and use of, gold through its activities in the World Gold Council.

2.3 Profile of Metso Minerals

Metso Minerals is the global leader in solutions for rock and minerals processing and metal recycling. The company's expertise is based on over a century of experience, and today's industry-leading solutions embrace the latest technology and an extensive service and after sales offering. Solutions cover a very wide range of industries, including:

- Construction and civil engineering
- Mining and industrial minerals, and
- Metals and demolition waste recycling.

Their know-how covers everything from individual machines – such as crushers, grinding mills, conveyors, and components – to complete systems and turnkey installations, and is complemented by a comprehensive range of installation and commissioning services, operational support, and training, together with wear parts and maintenance. Metso Minerals combines an extensive portfolio of brands, including such renowned names as Nordberg, Lokotrack, Barmac, Trellex, Skega, Lindemann, Texas Shredder, Flexowell, and Svedala. This is achieved not only through products that represent the best in their field, but also through a truly global presence, technical support, and consultancy services that allow customers to concentrate on their core businesses.

Metso maintains its core expertise in crushing, screening, grinding, conveying, separation, enrichment, and recycling through a comprehensive research and development program that incorporates true lifecycle thinking from product design onwards (www.metsominerals.com).

Metso's values

Metso Minerals shares Metso's values: Customer's success, profitable innovation, personal commitment and professional development. These values form the base for decision-making in daily work.

2.3.1 Corporate background

Headquartered in Helsinki in Finland, Metso Minerals has annual net sales of over 2.6 billion (2007). Personnel number is over 10,000. Metso Minerals forms part of Metso Corporation – a €6 billion-a-year group (2007) listed on the Helsinki Stock Exchange – that also includes Metso Paper and Metso Automation. Metso Minerals accounts for approximately 41% of Metso's consolidated net sales. The company has 38 manufacturing plants, and 146 sales and service units in 45 countries. Including authorized distributors and agents this gives us a local presence in over 100 countries worldwide (www.metsominerals.com).

2.3.2 Metso Growth Strategy

Metso's strategy aims to secure the continuity of sustainable, profitable growth over the business cycle. The profitability improvement is based on continuous improvement of Metso's own operations to enhance productivity, operational excellence, quality and cost competitiveness. To grow, Metso exploits the opportunities offered by the company's global presence, leveraging its service and environmental businesses as value drivers.

Metso's strategy is based on longer-term strategic framework consisting of its purpose, values, ethical principles and vision.

Metso's purpose is Engineering Customer Success. This purpose, together with the values and ethical principles forms a foundation for Metso's vision to become the industry benchmark.

Metso's strategic goals, which address operational excellence and customer satisfaction, act as a roadmap to Metso's vision. The shorter-term management agenda defines the current focus areas and priorities in customer satisfaction development and operational excellence, which are required to attain profitable growth.

Metso has also set financial targets, which measure Metso's continuous improvement and its capability to create long-term shareholder value. Metso targets an average annual net sales growth of over 10% and operating profit margin (EBIT-%) exceeding 10%.

2.3.3 Organisation

Metso Minerals' operations are divided into three business lines: Construction, Mining; and Recycling that channel their sales through market areas.

- The Construction business line serves quarries and project-based crushing and screening operations providing services to aggregates and construction industries, contractors processing rock or soil for the construction and civil engineering industries, and engineering and consulting companies.

- The Mining business line provides services to mining and industrial minerals companies extracting, processing and transporting ores and minerals, as well as to mining contractors, and engineering and consulting companies.

- The Recycling business line mainly serves the metal recycling industry including ferrous scrap operations, automotive industry, aluminium industry and foundries. Most of Metso's product and service offering is sold through their own sales and service units, or through their authorized distributors and agents around the globe.

2.4 Sandvik Mining and Construction Profile

Sandvik Mining and Construction is a world-leading provider of equipment and solutions for mineral exploration, underground mining in hard and soft formations, surface mining and bulk materials handling and specific areas of the construction industry, such as quarrying, tunneling, demolition and recycling and other civil engineering applications. Their range of products include rock tools, drilling, excavation, crushing and screening machinery and bulk materials handling systems.

Every product is backed by extensive R&D, application expertise, a network of authorized dealers, on-site service and training, and aftermarket support.

Sandvik has a tradition and a conviction that there can be no substitute for direct service and direct contact with their customers. Their service-oriented global organization is well developed and has more than 3500 service technicians strategically located all over the world

working for customers. Today Sandvik Mining and Construction has approximately 15,200 employees and operations in 130 countries (www.tamrock.sandvik.com)

2.4.1 Types of mining and projects involved in Ghana

Sandvik is currently involved in the supply and support of equipment for gold mining at the Gold Fields Ghana Tarkwa and Damang mine sites, Anglogold Ashanti Company Ltd, Obuasi and Bibiani mines as well as for Moolman Mining at the Sadiola, Yatela Mines in Mali and Sigiuri and Fayalala in Guinea.

2.4.2 Equipment Supplied and Service Contracts

Tamrock surface and underground drills Driltech Mission blast hole and water bore Drills Toro and EJC underground loaders and trucks Sandvik Rock drilling tools Driltech Mission drilling tools (DTH hammers and bits) Sandvik Rock Processing crushers and screens Rammer Rock Breakers Fleetguard Filters.

Sandvik has a Maintenance and Repair Contract to maintain the drilling Fleet for Gold Fields Ghana Ltd. at the Tarkwa Mine and also has contracts to supply service support to Moolman Mining in Mali. This has been in place for nearly two years. They also supply service personnel to Bogoso Gold Mines on an as required basis. They also have Supply Contracts with Gold Fields Ghana to provide Sandvik Rock Processing Parts and Manganese for their Crushers (www.tamrock.sandvik.com)

2.4.3 Environmental Policy

Sandvik Mining and Construction Region Africa's environmental policy is to be a responsible corporate citizen in protecting the environment. They are committed to complying with accepted environmental practices, including the commitment to meet or exceed applicable legal and other requirements, to strive for continual improvement in our environmental management system, and to minimise the creation of waste and pollution.

They therefore manage the processes, materials and people in order to ensure the reduction of the environmental impacts associated with their work. Risk assessments are conducted regularly to identify areas which need further action and they provide employees with the resources and knowledge necessary to comply with the requirements expressed in the policy.

Sandvik is in the process of implementing the ISO 14001 Environmental Management System to further enhance environmental performance. Their main objectives are:

- To increase efficiency in the use of energy and raw materials
- To reduce emissions to air and water
- To increase internal and product recycling

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

In this chapter the findings from a comprehensive literature study has been outlined. By doing so, we have sought to provide the reader with a thorough understanding of the areas and concepts related to the study. First, the genesis of supply chain management is discussed and in more detail, the importance of partnerships. Next, the concept of VMI in terms of barriers and requirements, and the impacts in specific business areas is examined. Last, the importance of performance measurement is stressed, as well as momentous criteria to consider when entering a partnership.

3.2 Supply Chain Management

The concept of Supply Chain Management (SCM) was first introduced in the 1980s and has since then grown rapidly in acceptance after companies have seen the benefits of collaborative relationships within and beyond their own organisations (Lummus & VokurGGL, 1999). A number of definitions have been proposed concerning the concept of SCM. Lummus and VokurGGL(1999) argue that SCM encompasses all the activities involved in delivering a product from raw material to the end customer's product and thus improving the long term performance of the individual companies and the supply chain as a whole. In similarity, Christopher (1998) states that SCM can be seen as the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole. An integrated supply chain as such, can be seen in figure 3.1.

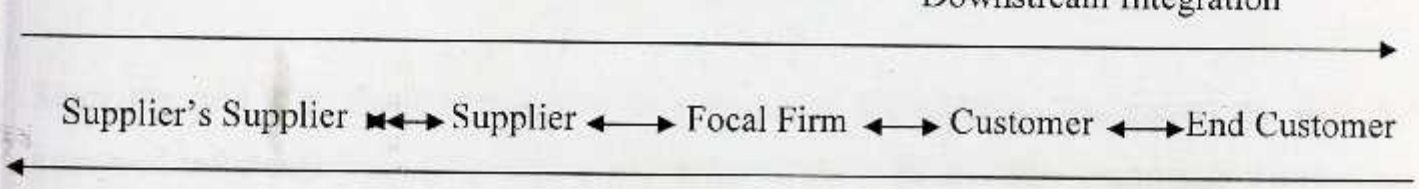


Fig. 3.1 An integrated Supply Chain

Further, Lummus and VokurGGL (1999) state that there are a number of driving forces that can be said to have led to the importance of SCM. The first reason stems from the changing customer buying habits that are due to an increased national and international competition. The previous solution was to hedge against the uncertainty by holding high levels of inventory. However, the dynamic nature of the market place has not only made this a risky and costly act, but also made it hard to provide value to the end customer. Secondly, firms have realised that maximising performance in one area within the company or the supply chain may have negative implications for other parts. Instead firms need to take on the more holistic view that SCM offers. The holistic view also leads to the third force, which states that firms have understood that it is only when firms cooperate and work as one unified supply chain that benefits for the individual firm and the whole supply chain can be gained.

3.3 Supply Chain Partnership

Supply chain partnerships are formed between two supply chain actors through cooperation, including an increased level of information sharing between each other. The relationship focuses on creating a win-win solution for both parties and to benefit in turn from reduced inventory levels and cut costs (Yu et al., 2001; Rowlands, 2005). Long term benefits for all supply chain members are emphasized, which is the basic goal of forming information sharing partnerships. Moreover, the mitigation, or even elimination, of the bullwhip effect has a specific focus in a supply chain partnership. This is explained as, when variability of an upstream member's demand is greater than that of a downstream member (Lee, So & Tang, 2000). Further, when this is not communicated to other actors, inventory and production decisions are solely based on the order information from the next downstream player (Yu et al., 2001). In other words, the whole supply chain faces several inefficiencies when the bullwhip effect is current. Lee, Padmanabhan and Whang (1997) argue that excessive inventory investments, poor customer service, inefficient transportation and missed production schedules are common in such an environment.

Since the mid 80s, the development of information technologies has paved the way for increased information sharing and collaboration between firms. New organisation structures have emerged to counter today's uncertainties that the supply chain network faces (Jaffee, 2001). Specifically, sources of uncertainties that affect the network chain derive from suppliers, manufactures and customers. These threats can, for example, stem from delayed deliveries, machine breakdown, and order frequency. They all result in increased logistic

costs and inefficient use of companies' resources. This is why supply chain actors today are more or less forced to redesign and alter their inventory control and welcome organizational change and become more flexible (Yu et al., 2001).

However, organisational uncertainty can not completely be eliminated. Jaffee (2001), further states that the main task for the firms in a formed partnership is to manage the uncertainties through decisions made based on increased information sharing. Information technologies make this possible, in a rapidly changing environment. Through, for example, EDI and inter-organisational systems employees have access to necessary information and can manage predictable uncertainties. Compared to a traditional business environment where purchase orders and invoices are sent, using paper documents, EDI allows the manufacturer to exchange this type of information in a computer processable format (Fu, Chung, Dietrich, Gottemukkala, Cohen & Chen, 1999). Furthermore, sharing information will enable the organisational structure to become more decentralized and flexible. Information will be shared and accessible through out various departments and functions, which will lead to more qualitative decisions (Jaffee, 2001; Rowlands, 2005). In other words, a flatter organization with an integrated information structure will respond better to environmental uncertainties and threats.

3.3.1 Organisational Structure and Collaborative Culture

Traditional organisational theory argues that a decentralized firm manages its organization more effective, where specific individuals have decision rights. The supply chain and its decision structure look somewhat different. Here, many individual organisations belong together in a chain, but still have their own decision and organisational structure (Yu et al., 2001). This complicates things when each firm acts alone to optimise its costs and benefits. The up-stream power structure is played out when, for example, a firm acts on maintaining ones inventory stock low and puts pressure on upstream members in the supply chain. Even though the individual firm performs more efficiently, it does not necessarily add to the overall supply chain improvement. Instead, information barriers and lack of communication between the members will result in a "broken" supply chain with piled up inventory (Jaffee, 2001).

Barratt (2004) adds to the discussion above and argues that a collaborative culture is needed when forming partnerships with other supply chain actors. He presents four main elements

that should be analyzed to see if one's firm is ready to implement a major change that will affect the entire organisation. Firstly, Barratt (2004) states that trust is a vital ingredient both within the firm and between the two partners. Trust between internal departments will contribute to the long-term stability of the company; while a supply chain partnership is built on a certain degree of trust and commitment. A collaborative cooperation also must stem from mutual benefit- and risk-sharing. As stated before, an "I win solution" and "You figure it out on your own" does not categorize this kind of partnership. Both actors need to have mutual respect for one another and find a "win-win solution". Furthermore, the need of information sharing is essential for a successful supply chain relationship. Information should be shared through broad lines of communication channels, where innovative thinking is encouraged and supported. This is done by having several contact persons between the firms communicating over EDI or other information system connection, rather than only having one single point of contact. Moreover, a high level of information sharing enables a VMI strategy. More specifically, the supplier will be responsible for when and how much the up stream actor's inventory will be replenished (Yu et al., 2001).

The last fundamental part of having a collaborative partnership is the need of having an open-minded culture, (Barratt, 2004). That is to say, the firms should have an innovative mindset and work for continuous improvement.

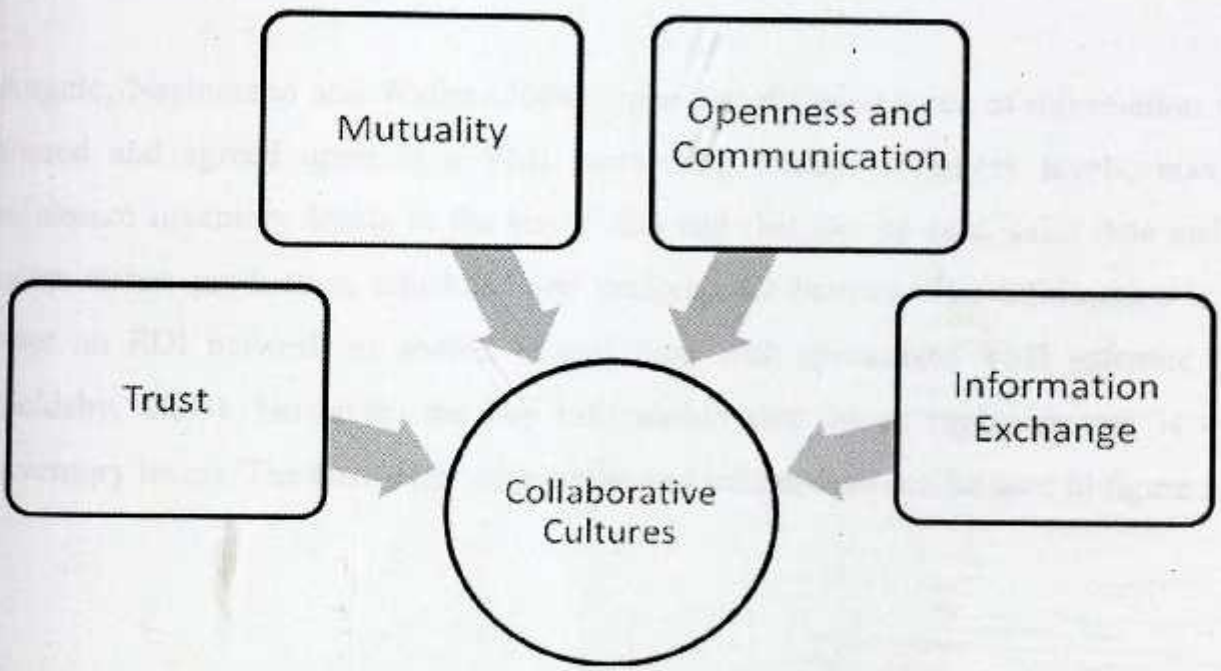


Figure 3.2 The Cultural Elements of Supply Chain Collaboration (modified from Barratt, 2004)

As figure 3.2 shows, four cultural elements contribute to the partnership's collaborative culture and add value to the partnership. Further, information exchange will develop trust, respect, and commitment between the partners. This will, in turn have a positive effect on the overall supply chain performance.

3.4 Vendor Managed Inventory (VMI)

As aforementioned, in traditional buyer/seller relationships both of the actors often strive to optimize their own operations independently, resulting in sub-optimal performance of the combined operation and the supply chain as a whole. However, with VMI, which is a type of relationship within SCM, a more efficient replenishment practice can be achieved by letting the vendor (supplier) respond to undistorted and timely demand information in order to pull the products through the channel (Holmström, 1998). In similarity Vendor ManagedInventory.com (2006a) defines VMI as "A means of optimizing supply chain performance in which the manufacturer is responsible for maintaining the distributor's inventory levels". Waller et al. (1999) state that VMI is some times referred to as supplier managed inventory depending on where in the supply chain the relationship takes place, However, in both cases the vendor monitors the buyer's inventory levels (physically or via electronic messaging) and based on that, takes re-supply decisions regarding order quantities, time, and way of shipping. The replenishment responsibility is, therefore, shifted over to the supplier, who bases the decision on the shared information.

Angulo, Nachtmann and Waller (2004) argue that different types of information that can be shared and agreed upon in a VMI partnership include inventory levels, maximum and minimum inventory levels at the buyer side and that can be sent, sales data and forecasts, order status, production schedules and performance metrics. The information is often sent over an EDI network or shared in real time with specialised VMI software (Pohlen & Goldsby, 2003). However, the key information that drives replenishment is the buyer's inventory levels. The basic flow of material and information can be seen in figure 3.3.

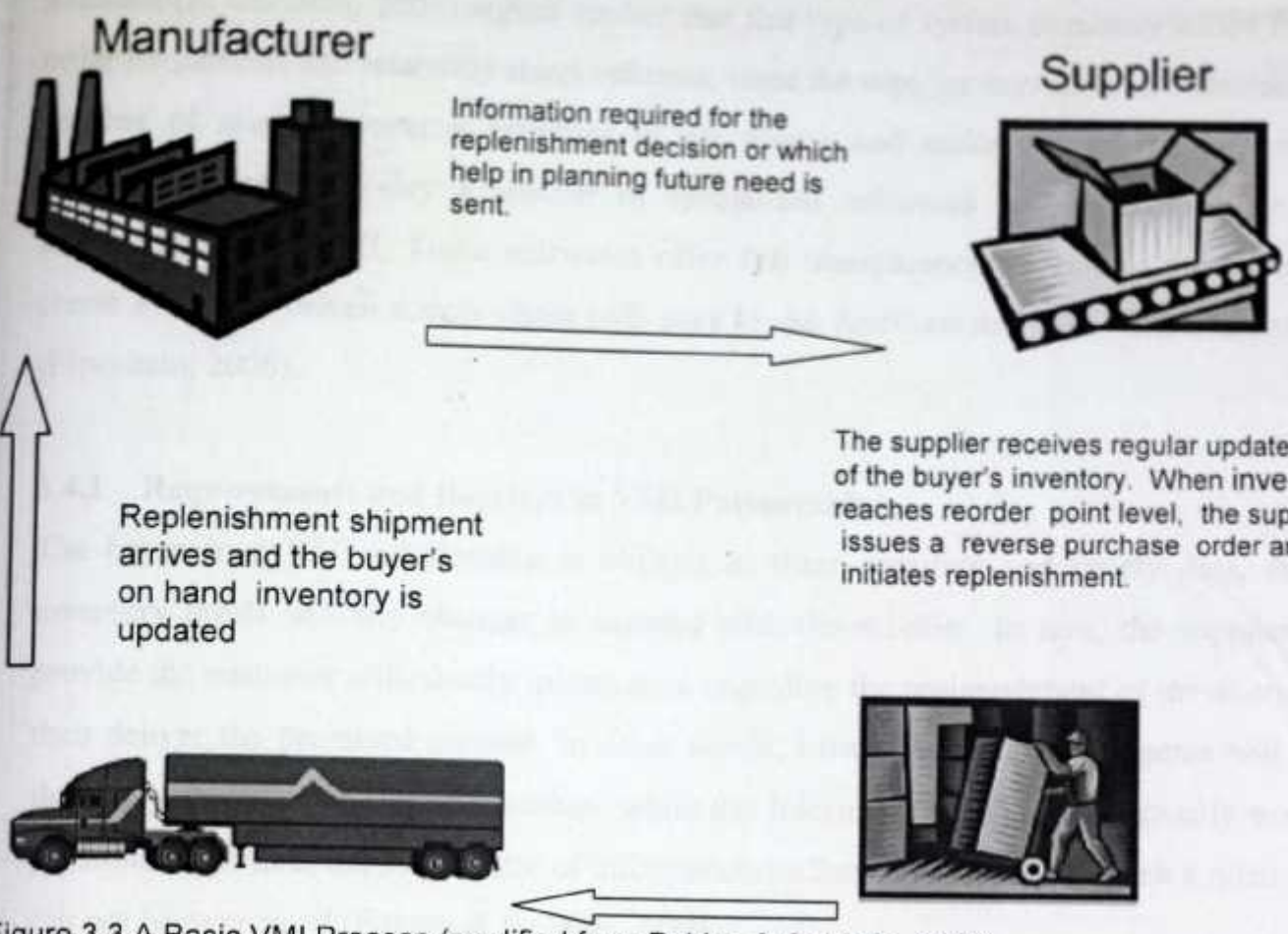


Figure 3.3 A Basic VMI Process (modified from Pohlen & Goldsby, 2003)

A big reason to why EDI often is used is because companies can build on their existing information system. That is to say, no significant investments have to be undertaken. Nevertheless, using EDI means that inventory information is sent as electronic standardized messages, for example, on a daily or weekly basis depending on the demand rate. The supplier matches this information to a previously determined reorder point. When the reorder point has been reached a purchase order acknowledgement is sent, which the buyer uses to update the system information. The supplier then picks and ships the order and at the same time sends out an advanced shipping notice that tells the buyer exactly what is being sent and when its been shipped. This facilitates for the buyer to match the purchase order to what has actually been received. Lastly the invoice is sent (VendorManagedInventory.com, 2008). In contradiction, Matsson (in Gattorna,2003) states that in some cases information needs to be provided and made accessible in real time. The supplier is then connected on-line with the customer's business system and is, therefore, able to plan inventory replenishment activities directly in the customers system. In other words, the supplier may have access to information such as inventory levels and incoming orders, which is of significant sense in a VMI relationship.

Matsson (in Gattorna, 2003) argues further that this type of system is mostly suited for low order frequencies and relatively small volumes, since the supplier may have to undertake a number of manual working activities to get access and make use of the information. However, there are today a number of specialised softwares tailored for supply chain collaboration and VMI. These softwares offer full transparency and allow the partners to create a demand driven supply chain with easy to use functions and with little manual work (Pipechain, 2006).

3.4.1 Requirements and Barriers in VMI Partnerships

The buyer in a VMI relationship is obliged to share sensitive and timely data, such as inventory levels and any changes in demand with the supplier. In turn, the supplier must provide the customer with timely information regarding the replenishment of inventories and then deliver the promised amount. In other words, trust ensures that each actor will fulfill their requirements for the relationship, while the information technology actually makes it possible. Therefore, the importance of information technology and trust in such a relationship can not be overstated (Pohlen & Goldsby, 2003).

Daugherty, Myers and Autry (1999) argue that a firm's information technology capability preferably should at least include a decision support system, a product identification technology and a communication channel, such as EDI. In similarity, Kaipia et al. (2002) state that standard product identification and integrated information systems are of great importance in a VMI relationship. The former is according to Angulo et al. (2004) important in order to assure that information is accurate. That is to say, reduce the number of errors in the shared information caused by the customer's inventory system. The authors argue further that using obsolete or inaccurate information will result in process inefficiency, excess costs and rework. However, these components should be considered as enablers and not absolute requirements for the relationship. This is partly in line with Holmström (1998) who argues that an implementation of VMI does not need complex technology, the true critical success factor lies in co-operation and a common understanding of processes and procedures. Angulo et al. (2004) state that poor understanding will result in an inadequate communication structure and that there will be a delay in information. In other words, poor VMI performance will result since information is delayed before it is used. However, Kaipia et al. (2002) affirm that one factor that acts as a major barrier to a successful VMI partnership is the intra- and inter organisational uncertainty about potential benefits and sacrifices.

Pohlen and Goldsby (2003) argue that there are several organisation barriers that have to do with uncertainty prior to implementation. The customer firm's management may think that they hand over too much responsibility and thus are too dependent on the performance of an outside company since they perceive to have a loss of control over key products.

Furthermore, Daugherty et al. (1999) argue that firms may be unwilling to invest in EDI or specialised VMI software that are used to share proprietary/confidential information that can be released to competitors. On the other hand, the supplier firm may view the relationship as unfair, believing that the customer is reaping all the benefits whiles the supplier only faces burdens (Dong & Xu, 2002). Pohlen and Goldsby (2003) argue further that the supplier may need additional personnel to handle inventory and planning tools for forecasting and inventory management.

Additionally, the customer may require the supplier to replenish the inventory on a consignment basis (see section 2.5), which will have negative impacts on the suppliers cash flow. Therefore, to avoid inter- and intra firm barriers the senior management within each firm must identify the VMI partnership as a strategic objective and then communicate it throughout the organization to gain commitment at all levels in the organization (VendorManagedInventory.com, 2008). The author argues further that it is of significant sense to get all employees to accept the concept, especially the personnel responsible for maintaining the inventory levels. This is done by providing a complete overview of what impacts VMI will have on the company and why it is important. Pohlen and Goldsby (2003) state that in order to overcome the critical implementation barriers and to help managers communicate within and across firms they need to be able to measure the potential benefits.

3.5 Aligning Performance Measurement with SCM

Most companies have understood the importance and the potential of SCM, but in order to realize the stated benefits they must be able to measure them. There are a number of driving forces for this, but according to Pohlen and Lambert (2001), the key forces are to align the metrics with the company's strategy and objectives, and the need to identify and allocate benefits and burdens in order to encourage cooperative behaviour. In similarity, actors in a supply chain, are unlikely to achieve their internal and joint goals unless their performance measures and incentives are aligned. Traditional measures are not aligned with strategies and objectives and may actually result in inefficiencies for the overall supply chain. In coherence,

many authors have emphasized the importance of looking at the concept in organisations as a key managerial task integrated within the wider activities of planning, organising activities, motivating people and controlling events. In this context, performance measurement can be seen as a part of a supply chain strategy, which uses a broad set of metrics to monitor and guide an organization within acceptable and desirable parameters (Morgan, 2004). Nevertheless, Gunasekaran, Patel and Tirtiroglu (2001), state that even though many firms have realised the potentials of aligning performance metrics with SCM, they often lack the knowledge on how to develop these metrics. Robson (2004) argues further that since there are a vast amount of ways of measuring performance, many managers often face the state of "paralyze by analyze". Therefore, it is important to understand the need for measurements and, based on that, identify the minimum, but broad set of measures that drive performance.

Additionally Maskell (in Gunasekaran et al. 2001), suggests that these key metrics have to be a balanced mix of both financial and non-financial measurements. Financial measures are indeed important for strategic decisions, but non-financial measures are better at handling the control of day-to-day operations. Consequently, having said that VMI is a collaborative logistical program that will have an impact in many different areas both internally and externally, one can easily understand that managers are in great need of a balanced and well-founded analytical approach that can assess benefits and burdens, and then sell the innovative program within and across firms. This is also in line with Matsson (in Gattorna,2003) states that when implementing VMI it is of significance sense to understand and be able to follow how costs and activities are reallocated across and within both partners.

3.5.1 Total Cost of Ownership (TCO)

Today, there are a number of models that can be used in relatively broad terms to assess logistical performance and connect it to company expenses. One model that has its focus on the company's logistical costs is the Total Cost of Ownership (TCO). This model separates the costs and can, therefore, serve as a good starting point to get an overview of the firms total logistical costs (Jespersen & Skjøtt-Larsen, 2005). According to Lambert, Stock and Ellram (1998), TCO can be divided into the areas of service, order processing, transportation, inventory and lot quantity costs. However, the latter can also be seen as a pure production cost. The authors also state that these costs are interrelated and; therefore, have to be analysed in relation to each other. This is also in line with Lambert and Burduroglu (2000), who argue that the basic idea of TCO is that real savings can only be achieved by focusing on the total

cost of logistics and not by trying to reduce costs of individual logistical activities. This is essential since cost reductions in one area can lead to increased costs in another and in the end raise the total costs. The authors argue further that TCO can be used to assess logistical performance both internally and externally. Jespersen and Skjøtt-Larsen (2005) suggest that by using TCO one can illustrate how much SCM cooperation can increase overall savings, and thus why it is important to focus on costs when collaborating. Since logistics is a major cost of doing business and the fact that this cost stands for a considerable share of a company's total costs, big savings can be gained by the firm. Nevertheless, it is important to remember that the goal should be to reduce supply chain costs and not just pushing them over to another firm. However, the shortcoming of exclusively using the TCO analysis as the basis for decision making is that there is a risk that the analysis is solely optimal from a cost perspective and not when looking at total company revenue. This is because the cost view is not broad enough and due to the fact that sales implications are ignored (Jespersen & Skjøtt-Larsen, 2005). Therefore, a more comprehensive tool that fulfils all of the previous mentioned critical criteria is needed.

3.5.2 Economic Value Added (EVA)

Economic Value Added (EVA) is a tool that can help managers to implement and assess reengineering programs such as VMI, and to see how the company's total value will be affected. According to Lambert and Burduroglu (2000), value is the best measure because it is the only measure that requires complete information. No other metrics are that comprehensive and have such a long-term goal as value. In addition, Jespersen and Skjøtt-Larsen (2005), state that the model serves well as a discussion tool both internally and in the supply chain, when estimating how potential improvements and results of closer collaboration can affect value.

By undertaking a combined EVA analysis of the supplier-customer relationship, managers can see how VMI will affect value creation within both firms. That is to say, EVA provides the capability to evaluate the effect of VMI simultaneously from the supplier's and the customer's point of view. Management can then use the combined analysis to identify which actions need to be taken and in which areas across both firms, in order to drive supply chain profitability or value creation (Pohlen & Goldsby, 2003). Jespersen and Skjøtt-Larsen (2005), state that a company's performance can be affected in four general areas: revenue, cost, working capital and fixed assets. The analysis helps managers to identify the financial and

non-financial value drivers of VMI, within these areas, and at the same time translate performance into financial results for both firms. However, Lambert and Pohlen (2001) state that to be able to achieve this managers must link the value drivers with key performance measures at the lowest level of the organisation. In other words, they have to convert financial objectives and value drivers into specific metrics that align behaviour at the task and activity level (Pohlen & Goldsby, 2003). The authors argue further that this is done to see how performance directly impacts on the creation of value. Putting this in a VMI context, the aim is to establish a clear cause and effect linkage from individual performance to the financial outcomes of the relationship. In addition, the technique also fosters an individuals' understanding of how they and VMI contribute to the organisation's overall performance.

3.5.3 Integrating EVA and TCO

As previously argued a good starting point is to get an overview of the company's logistical costs by analysing the different areas in the TCO concept and then undertaking a more thorough analysis with EVA. However, instead of separating the two analyses we decided to integrate the two models in order to extend the TCO method and to clarify the EVA tool, which can be seen in figure 3.4. Sales will be analysed exclusively from an EVA perspective since TCO does not consider any revenues. On the other hand, production costs will be investigated together with EVA since the main production benefits are those that impact on cost of goods sold and fixed assets. Furthermore, the EVA variable total expenses will be divided into order processing costs, service costs and transportation costs to facilitate the VMI analysis. However, TCO's and EVA's inventory variable will be viewed as corresponding, while the variable other current assets will be linked to order processing.

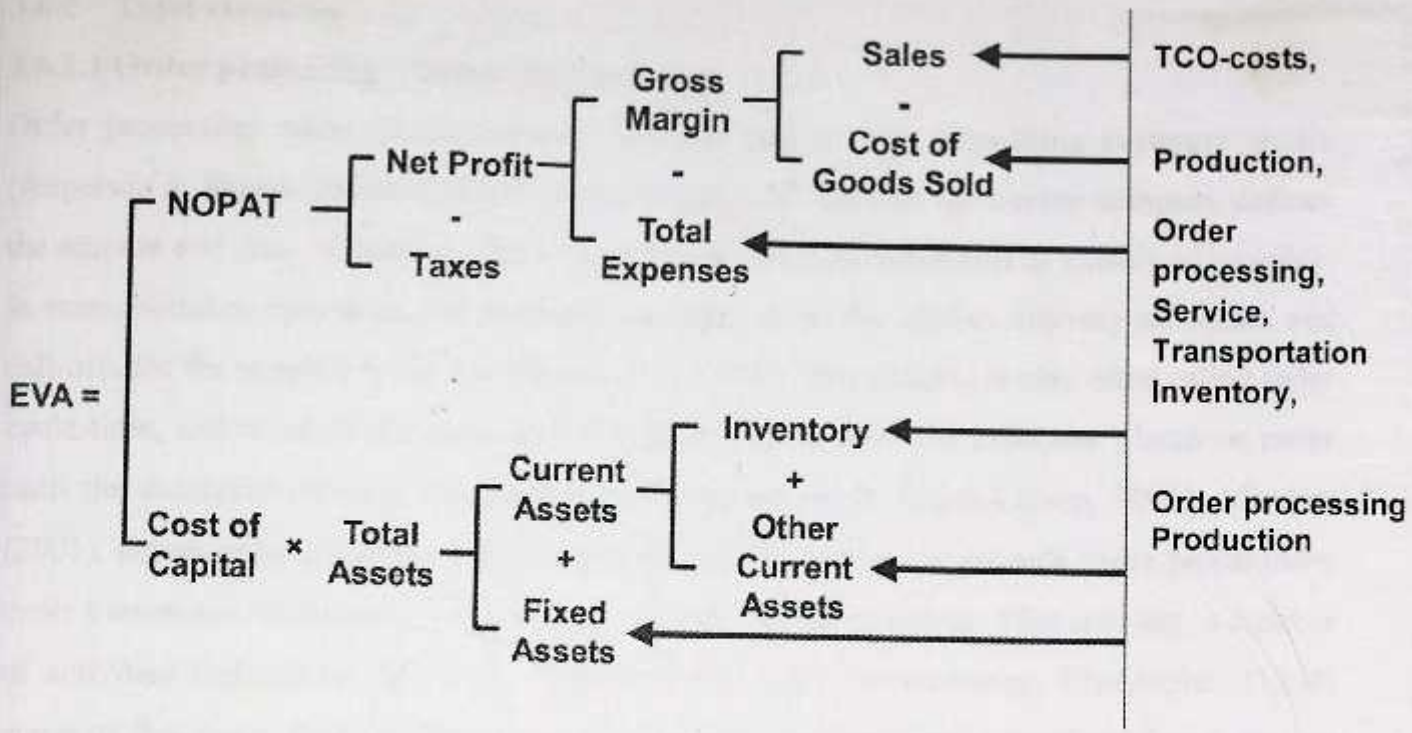


Figure 3.4 EVA and TCO Areas

3.6 VMI Impacts on EVA/TCO Variables

3.6.1 Sales

Pohlen and Goldsby (2003), state that sales are closely related to service. That is to say, by having high service levels to customers and at the same time receiving good service from suppliers, increased sales volume can be gained by reducing out-of-stock scenarios, which can be the case when ordering in the traditional way. The authors also suggest that by having good service standards towards customers, companies can benefit and increase sales from better relationships and the retention of profitable customers.

Since VMI provides the supplier with key information that help the supplier to plan production and deliveries, the supplier's and thus the buyer's service levels will improve (Waller, Johnson and Davis, 1999). The authors argue further, that increased sales is not just the effect of more on-time deliveries, but also more just in time deliveries. Lastly, Christopher (1998) states that, since VMI is a long-term practice both the buyer and supplier will benefit from an improved partnership and the supplier can often guarantee sales in the long-run. Matsson (in Gattorna,2003) also affirms that the latter can be the case since the duration of contracts often are extended in order to assure a long term relationship.

3.6.2 Total expenses

3.6.2.1 Order processing – Other current assets

Order processing refers to all activities that are tied in with expediting customer orders (Jespersen & Skjøtt-Larsen, 2005). In a traditional order process the buying company defines the amount and time of delivery, the suppliers task then is to fulfill this as exactly as possible. In manufacturing industries, the customer company normally applies delivery schedules and call-offs for the supplier to follow (Kaipia et al. 2002). This process is also often called order cycle time, and refers to the total time that passes from when the customer places an order until the customer receives the desired goods (Jespersen & Skjøtt-Larsen, 2005). Mentzer (2001), agrees with the above authors, but extends the concept to include order preparation, order transmittal, order entry, order filling and order status reporting. That is to say, a number of activities that contributes to the administrative costs. In similarity, Christopher (1998) suggests that cycle time can be viewed as a complex concept with a number of cost driving activities. The author argues further that having a long order cycle time also result in negative implications that are due to greater reliance on long-term forecasts and a bad cash flow. Therefore, having a short order cycle time can be seen as a major source of competitive advantage.

Even though authors have argued that computer systems, such as EDI have helped in decreasing the order transmission time, there has been an enhanced customer focus of having deliveries to be made within short time frames, which has made order cycle times to continue to be at the centre of attention (Mentzer, 2001). In coherence, Kaipia et al. (2002) state that problems in the order-delivery process has resulted in a high rate of late and incomplete order deliveries, even though the increased use of sophisticated information systems. The authors suggest that the point here is that orders are an inefficient form of transferring information. Thus, by effectively managing order processing, companies can not only reduce costs, but also improve customer relationships (Mentzer, 2001).

Kaipia et al. (2002) affirm that by using VMI the traditional order-based replenishment system can be substituted by a much more effective process. The benefits will be realized when handing over responsibility and authority for the entire replenishment process and not just putting pressure on supplier performance by requiring faster and more precise deliveries. Waller et al. (1999) state that, the ordering process can be significantly improved since the supplier can simply decide when and how much to replenish by monitoring the buyer's

inventory levels. However, by continuously monitoring the customer, an extra activity and time is added. On the other hand, the customer no longer has to undertake order preparation, order transmittal and order entry activities. In coherence, Angulo et al. (2004) state that the administrative costs can be cut significantly. In addition, Waller et al. (1999) argue that since unnecessary steps in the order process can be eliminated or the time spent on each activity can be considerably reduced, also the order cycle time will be decreased. Additionally, Pohlen and Goldsby (2003) state a more efficient and faster order process also result in improved cash flow and thus reduced other current assets.

Lastly, Christopher (1998) affirms that the intensified information sharing and the lower cycle time also make it easier to rely less on forecasts. This also has positive implications on the order filling process. This is because VMI makes it possible for firms to coordinate buyer orders, which result in the fact that errors in the on-time and in-full delivery process can be avoided.

3.6.2.2 Service

Cohen and Roussel (2005), state that one way of achieving a competitive advantage is by competing on service. The successful firms in this category will be the ones that have understood and managed the relationship between cost to serve and increased profitability. Nevertheless, Christopher (1998) argues that the basic relationship between the level of service and the adherent costs is often illustrated as a steadily rising curve. This adverse relationship can also be seen by looking at two basic performance measurements, namely service levels, such as in-stock and inventory levels (Waller et al. 1999). The authors affirm that these two measurements are conflicting since the buyer often stock up at the beginning of the month to assure high service levels and then let inventory drop by the end of the month to meet inventory objectives.

Kaipia, Holmström and Tanskanen (2002), argue that a purchasing behaviour, as the above stated, will have severe impacts at the supplier side as well. Since service requirements are high the supplier tends to over stock to be able to meet the demand spikes on a short term notice. The authors also suggest that this is one of the main reasons for the genesis of demand amplification in the supply chain, also know as the bullwhip effect. However, with VMI companies can assure high service levels, while keeping costs low. This is because of the continuous exchange of information that takes place between the buyer and supplier

(Christopher, 1998). Angulo, Nachtmann and Waller (2004), affirm that the exchange of information result in improved production planning and thus improved service levels. In other words, instead of just reacting to big bulk orders by the end of the month the supplier can plan in advance, when and how much of a specific product should be delivered. Thus, service levels can be kept high, while costs, at the same time, are kept low. The authors also stress that if the inventory planning and the replenishment process is handed over to the supplier, also the buyer will benefit from higher service levels and lower costs. Since VMI has positive impacts on service levels for both actors, it will help when negotiating new service standards.

3.6.2.3 Transportation

Transportation can be seen as the spatial linkage for the physical flows in a supply chain. In addition, transportation also involves the time and place utilities of getting goods to the right place at the right time in response to customer requirements. Furthermore, the financial impacts of inventory and transportation costs also have to be kept in mind (Mentzer,2001). Gattorna (1990) states that the cost drivers often are measured in terms of volume, weight, number of deliveries and fuel. However, Waller et al. (1999) state that, since orders from the buyers regularly are received simultaneously and in bulk form, the supplier will often find it impossible to coordinate and fulfill all delivery requests on time and in-full. The result is that the transports are characterised by high-cost less than full truckload shipments, and not by the preferred low-cost full truckload shipments. Nevertheless, Waller et al. (1999) affirm that with VMI the supplier is allowed to coordinate the replenishment process instead of automatically responding to buyer orders. Therefore, increased transport utilisation can be achieved were fully loaded and timely transports are sent to the buyer site. Moreover, facilitating transportation planning allows for efficient route planning, where one dedicated truck can make multiple delivery stops at several nearby customers. Some authors have argued that transportation costs can actually increase due to the higher delivery frequency and thus number of transports.

3.6.3 Inventory – Current assets

Inventory management spans from the procurement of raw materials through to the delivery of finished goods and can, therefore, be viewed as assets of the firm. The effectiveness of this process will have major implications on both the financial and operational performance of an organisation (Heath & Danks in Gattorna, 2003).

Heath and Danks (in Gattorna, 2003) state that two components that have to be carefully considered in any type of inventory, be it raw material, work-in-process (WIP), or finished goods, are cycle stock and safety stock. Cycle stock is the most fundamental inventory function and is driven by the frequency of inventory replenishment. That is to say, the stock required to satisfy demand between replenishment. On the other hand, it is the additional stock required to hedge against demand and supply variability and to assure product variability. In similarity, Mentzer (2001), argues that inventory is used to cover up poor supply chain performance. In other words, instead of identifying the source of variability and uncertainty causing the problems, companies just increase safety stocks and in order to maintain availability. However, this behaviour may work in the short-term but in the long-term it only results in poor performance and high costs (Christopher, 1998).

According to Mentzer (2001), there are four major cost components when carrying inventory namely capital cost, storage cost, inventory service cost, and inventory risk. Capital cost is the largest cost component and refers to the value of capital that is tied up in inventory. Christopher (1998) affirms that fifty per cent or more of a company's current assets often are tied up in inventory. Mentzer (2001) argues further and states that storage costs are referred to the handling costs that occur when moving product into and out of the inventory. Furthermore, inventory service cost includes insurance and taxes, and is dependent on product value and risk of loss or damage. Lastly, inventory risk costs are those associated with obsolescence, damage and theft.

The concept of VMI helps firms to reduce costs and uncertainty by substituting inventory for information (Christopher, 1998). Angulo et al. (2004) state that since the supplier gain visibility of the buyer's demand information, uncertainty is reduced and thus the need for holding high levels of safety stocks. Moreover, since the supplier only deliver what actually is needed; also the buyer's raw material and component inventory will decrease. Waller et al. (1999) state that further improvements will be achieved through the increased visibility and control of inventory. That is to say, fewer products will be held too long leading to obsolescence. Additionally, Kaipia et al. (2002) argue that the enhanced relationship will result in improved inbound logistics, since the need for controlling orders can be reduced.

In other words, VMI will have a positive impact on both the firm's operational and financial performance. These benefits can mainly be seen in less raw material and component stock,

and in finished goods inventory. Moreover, costs generated by inventory risk, storage and tied up capital can also be reduced.

In addition to reduced inventory costs, Pohlen and Goldsby (2003) state that in some VMI relationships also the inventory ownership changes. Dong and Xu (2002) state that a VMI consignment arrangement exist when the owner of the goods, the consignor, delivers to its customer, the consignee, with the proceeds of the sale being remitted to the consignor only after the actual use/sale. Matsson (in Gattorna,2003) states that in these types of relationships; the supplier is often free to form the replenishment process. That is to say, decide upon delivery times and order quantities that are in line with the production plans and the current inventory levels. The supplier can, therefore, optimise and coordinate its own internal process by producing and delivering only when the specific item actually is needed.

However, Matsson (in Gattorna, 2003) argues further that working with consignment stocks requires even more carefully elaborated contracts. In a traditional VMI contract the most important parameters are the product quality and that the customer's inventory levels always are between the determined minimum and maximum levels. In addition to that are the issues of who is responsible for the stock-taking and who should pay for stock-taking discrepancies in terms of loss or obsolescence. The billing process can also become a matter because the customer often sends an invoice every time products are taken out of the inventory. This results in that the number of invoices that are sent will increase and the manual work, both at the customer and supplier side. In other words, consignment stocks are often viewed, by the supplier as an extra burden due to increased inventory carrying costs and increased work load, while the buyer often sees it as a great opportunity to reduce its holding costs, operational costs and improve cash flow. However, as aforementioned, if the supplier is suitable for a consignment stock arrangement and the contract is elaborated to fit both actors' needs, it can bring benefits to both parties.

3.6.4 Production – Cost of goods sold and fixed assets

The need to be flexible and be able to adapt to changes in the market has become the key to success for many companies. Manufacturing can be seen as the core in most companies, which has the important role of helping the firm to become flexible (Mentzer, 2001). However, Gattorna (2003) states that even though the importance of flexibility is known in most companies' managers often get stuck in old production principles. That is to say,

achieve flexibility by having high inventory levels that can meet customer demand, which are supported with a high asset utilisation. In other words, many companies tend to focus on running long production runs in order to reduce production costs and changeover costs. According to Christopher (1998) this results in negative implications in terms of inefficiency and high amounts of tied up capital.

Waller et al. (1999) argue that the key reason to why companies have problems in planning their production is the volatile demand that they are facing. To be able to cope with the changing order patterns, the firms often over stock and invest in extra capacity to make sure that orders can be met.

However, with VMI the suppliers will face a much smoother demand signal, which allows for improved production planning. That is to say, orders can be coordinated and planned well in advance, resulting in lower buffer stocks while at the same increase asset utilization (Waller et al. 1999). Pohlen and Goldsby (2003) argue further that increased demand visibility also lower the need for excess capacity. Furthermore, the improved production planning followed up by more frequent deliveries also result in better plant and warehouse utilization since fewer inventories will be stocked, both at the supplier and customer side. On the other hand, the customer may benefit from more accurate inventory levels and product quality thus less production disturbances.

3.6.5 Summary of VMI Impacts on EVA/TCO Variables

EVA Component:	Effect on EVA	SMI/VMI Value Drivers:
Sales	↑	• Increase price through higher quality or service • Increase sales volume (higher on-shelf availability) • Improve margin • Retain profitable customers
Cost of Goods Sold	↓	• Improve manufacturing processes and productivity • Reduce cost of raw materials or products sold
Expenses	↓	• Reduce order placement and management costs • Reduce human resource costs • Leverage new or alternative distribution channels • Reduce general overhead and administrative costs • Eliminate forecasting and inventory management costs • Reduce freight and warehousing costs
Inventory	↓	• Reduce purchased goods inventories • Reduce work-in-process inventories • Reduce finished goods inventories
Other Current Assets	↓	• Reduce working capital
Fixed Assets	↓	• Improve warehouse and plant utilization • Increase asset utilization

Source: Adapted from Rappaport (1998, Figure 9-3); and Lambert and Pohlen (2001, Figures 6 and 7, pp. 10-11)

Table 3.1 VMI Impacts on EVA/TCO Variables (adapted from Pohlen & Goldsby, 2003).

3.7 Supplier and Product Selection in Partnerships

It has previously been stated that when implementing a more sophisticated supplier customer collaboration such as VMI, there is a need of a committed organisation. In addition, for the company to obtain the pronounced benefits as follow with a VMI implementation it can be argued that the customer must select suppliers, which have the highest potential for meeting the company's interests. With selection it means to make a comparison of suppliers using a widespread set of criteria. The level of detail of the supplier criteria may depend on the

This will lead to an establishment of a closer partnership between supplier and customer, for instance VMI. Strategic partnership is explained by Ellram (1990) as a relationship that is ongoing and mutual and where involved actors show commitment for a longer time period. Further, strategic partnership is also characterised by increased sharing of information the risks and benefits of the relationship. Moreover, a supplier-customer relationship can be based on a number of supplier selection criteria which can, in turn, be divided into generic criteria such as the type of supplier, type of logistics flow and the type of relationship. (Svensson, 2004).

Furthermore, Masella and Rangone (2000) emphasize two issues that are relevant in a context of supplier selection in co-operative relationships. Firstly, it concerns the identification of what selection criteria that should be considered in an assessment of potential suppliers, which will be stressed in this section. The second issue is the techniques used to evaluate, rank and select a particular supplier. Furthermore, their notion is that there are different procedures of how to select supplier depending on two features of the relationship between the supplier and customer. One feature is the reference time horizon of the relationship, which is divided into short versus long term. The second feature is the content of the relationship in terms of logistic or strategic integration (Masella & Rangone, 2000).

Svensson (2004) presents a two dimensional model, which is based on how manufacturers within the automotive industry segment their suppliers. These two dimensions are made up by the supplier's commitment to the manufacturer and the commodity's importance to the manufacturer where each dimension can be divided into a low or high degree.

In addition, Lee, Ha, and Kim (2001) assert that the coordination between suppliers and manufacturers within the supply chain is very difficult but of high importance because the suppliers can be considered as manufacturer's external organisations. They continue by saying that a failure in coordination implies excessive delays, which in the end leads to poor customer service. This results in increasing inventories of both incoming material and finished goods, which entails that the total cost of the supply chain will increase.

Moreover, four different categories of supplier selection criteria are proposed by Kahraman et al. (2003). In order to evaluate if a supplier is suitable for a customer's supply and technology

strategy, certain criteria are taken under consideration. These are developed to find out important aspects of the supplier's business. Thus, from a financial point of view the supplier should have a solid financial position, which can be an indicator on the long-term stability and if products will be available to a required performance standard. In similarity, Ellram (1990) argues that the financial issue is of great importance in the selection as financial instability will not contribute to the improvement of the partnership and in perhaps in the long term, not survive.

A relationship between companies also requires management stability and confidence from the customer in the supplier's ability to deliver, or in other words trust. Although, evaluating from the criterion trust is very intangible and is often done by intuition. From the supplier's management it is important to be committed to manage the supply in order to maintain a successful partnership. That is to say, the level of willingness by the supplier to adjust their strategy towards and, thereby, fit the strategy set by the customer. In order to communicate strategies and future goals effectively company's management compatibility is, therefore, essential (Ellram, 1990).

Moreover, the supplier criteria also consider technical aspects, which mean that the supplier will provide high quality products and work with future improvements. The customer needs technical support from its supplier (Kahraman et al, 2003). In addition, the implication of technology can also be the supplier's manufacturing facilities and their way of production (Ellram, 1990).

Other resources that are of significance in a relationship is the supplier's facilities regarding, for instance, sophisticated technology in order to facilitate information sharing between companies. Kahraman et al. (2003) also discuss quality systems and processes as key factors when selecting supplier. Criteria as such can comprise the supplier's quality assurance and control procedures, which are of significance for the customer. Moreover, it can also be geographical aspects that determines who is an appropriate supplier to have a partnership with. Suppliers from other countries can entail risks such as currency fluctuations and changes in regulatory. Besides that, the physical distance can be an issue (Kahraman et al. 2003).

Regarding the product, there are important functional characteristics that are used as criteria in the evaluation. The customer needs to examine quality of a product, storage requirements

and packaging, but also the use in manufacturing has to be considered (Kahraman et al., 2003).

The implication of these criteria can be the product's frequency of use, which determines a certain level of buffer stock. In addition, Van Hoek (2005) asserts that customers will obtain the most significant benefits through VMI if the demand volatility is low.

Purchasing includes order processing, delivery and support, which are examples of services, thus of importance in a selection. To evaluate the service performance of a supplier the customer can use certain criteria. Examine a supplier's customer support such as accessibility, timeliness, responsiveness and dependability, that is to say performance history, will provide an assessment of the supplier's appropriateness. Moreover, other criteria of relevance are the professionalism of the supplier, which implies knowledge, accuracy, attitude, and reliability (Kahraman et al., 2003). These criteria may vary depending on how important the customer is to the supplier. For instance, positive attitudes towards partnerships are most likely to increase if the concerned customer stands for a high share of orders. Furthermore, the frequency of delivery will have an impact on the inventory level for a particular product and is, therefore, an important criterion.

Kahraman et al. (2003) bring up a fourth criterion, which is cost and of great importance and highly connected to purchasing. Typical expenses that arise during purchasing are, for instance, price, transportation cost and taxes. Though, there are also expenses arising from an operational point of view such as transaction processing costs.

Finally, Kraljic introduced a matrix in the early 80's with the purpose to get the most out of a company's buying power and to minimize the supply risk. The matrix is composed by four categories where each one is well suitable for a particular supplier strategy. Strategic items, which is one category contains products that are of high volume and often specific for the customer. In this category there is only one source of supply available, which can not be changed without significant costs and the items stand for a high share of the cost of the end product. Furthermore, between the supplier and the customer communication is often intense and complex. Though, balance of power between the actors in this segment can appear differently, it can either be dominated by the buyer or the supplier, or a third option, which

differently, it can either be dominated by the buyer or the supplier, or a third option, which means that there is a balance and no part is dominant and both the supplier and the customer have mutual interest in obtaining a closer partnership (Gelderman & Van Weele, 2005).

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

In this chapter, two methodological frameworks are presented; the motivation for the choice of method for this study is also discussed. Moreover, an account for the process of selecting the case, as well as how data was collected is highlighted. This led to further discussion of the quality of the research.

4.2 A Quantitative versus a Qualitative Research Approach

Research can either be conducted with a qualitative or a quantitative framework. With a qualitative method, a higher level of understanding is gained through interviews, observations from field visits, case studies and various data collections (Kotzab, 2005).

The focus advocated by using the qualitative approach, is to explain an overview of the problem and keep an open mind of changing ones research question throughout the process. Flexibility and open mindedness are key words that describe this method approach. Furthermore, this approach enables the investigators to research and collect material gradually and then go back and collect more data if needed. The research work is viewed as a process and solutions are given in words and text (Maxwell, 1996).

On the other hand, when using the quantitative method, answers are gained and relationships found through analyzing and calculating statistics and relevant variables (Kotzab, 2005). In comparison to the qualitative method approach, solutions are given in numbers. Instead of studying how variable X causes variable Y, investigators focus on to what extent variable X cause variable Y (Maxwell, 1996). Data is mainly collected through questionnaires with given answer alternatives (Jacobsen, in S.M. Disney &D.R Towill 2003). The same questions are given to all respondents, which is different from personal interviews and discussions. Moreover, this strategy of making respondents choose from pre-set answers to describe the situation/ phenomenon puts strong limitations on the collected information (Jacobsen in S.M. Disney &D.R Towill 2003).

and analyzed much more efficient allowing a quantitative approach. Data that are processed quickly, can then give the researcher an idea about the robustness and the reliability of the results and from there make headway for decisions regarding, which method to use (Johns & Lee-Ross, 1998). The quantitative framework offers a clear start and finish line, compared to the interactive process that the qualitative approach advocates (Jacobsen, in S.M. Disney &D.R Towill 2003).

An interconnected approach, instead of taking one definite side can, therefore, be of more use when studying a new research area, such as SCM. Gorard (2003), states that taking sides can influence ones choice of what to research. Furthermore, Jacobsen (in S.M. Disney &D.R Towill 2003) adds that the two methods should not be seen as rivalry methodologies, but instead as two complimentary frameworks for ones study.

4.2.1 Research Methods in Logistics and SCM

Literature within SCM state that an interconnected approach is the most favourable method to use. A quantitative approach, in addition to a qualitative approach, should then be used. Kotzab (2005) advocates that, a combination of the two methodologies will give a stronger validity in logistic and SCM research. Rushton and Saw (1992) argue that one should not forget other important business applications when researching the supply chain network. Therefore, logistical statistics ought to be evaluated in compliment with qualitative approaches. Näslund (in Kotzab, 2005) agrees and states that logistic problems are often very complex and involves more than one or two actors. Therefore, the combination of two methodology approaches can help unravel and to better collect multiple data about a single problem along the supply chain. Moreover, the combination of the two approaches can be seen as a tool that can control the drawbacks from the different approaches (Jacobsen, in S.M. Disney &D.R Towill 2003).

4.3 Choice of Method

Someone who finds, uses and critiques all evidence relevant regardless of its form, is an ideal researcher, according to Gorard (2003). Aligned with the idea of complimenting the two perspectives in logistic and SCM research, I chose to use both frameworks for this thesis.

A qualitative approach has enabled me to investigate what really happens, that is, the outcomes of a VMI partnership between GGL and the chosen suppliers. Furthermore, this approach has paved the way to better understand and observe the attitudes and expectations towards an implementation of VMI in allied industries.

The logistic flows, however, have been researched through a quantitative viewpoint to find critical issues and areas to improve upon. Conclusions of this kind have been drawn from looking deeper into variables, such as inventory stock, lead-times etc.

Therefore, the two different approaches have been used to unfold the findings in various categories concerning VMI partnership, supplementing each other to present a more exact picture of the study. In addition, research questions were outlined, in order to help unfold a very complex and wide research area, as well as to keep me on track during the writing process. Furthermore, to gain a broad range of perspectives of VMI implications, I chose a case study approach, when gathering the empirical findings.

4.3.1 Case Study Approach

A case study strategy specifically pinpoints "why" and "how" an event occurs. Therefore, Yin (2003) suggests that research questions, which tend to have a focus on answering "What" and "where", should be complementary to one's case study. More specifically, the definition of a case study is that "it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented and with what result" (Yin, 2003). The word decision can also be replaced by, for example, "processes", "events", or"organisations". Furthermore, Yin (2003) states that a case study can be of help when investigating an event within its real-life situation and when the restrictions are not that obvious (Yin, 2003).

For my case study at Goldfields Ghana Ltd. (GGL), different suppliers and products criteria were collected and discussed in order to decipher why GGL should process specific VMI evaluations with certain suppliers. These criteria have been found in the theories presented in the theoretical framework, as well as from the continuous interviews with GGL. The particular criteria I found to be of great importance are presented in the empirical findings (section 5.2).

Based on the criteria, GGL chose two suppliers that matched these requirements. These suppliers were then evaluated in terms of benefits and potential effects of a VMI implementation, from both GGL and the suppliers' perspectives. In other words, two relationships have been thoroughly investigated. The two companies that were selected are: Metso Minerals and Sandvik Mining and Construction. The two products chosen were somewhat different concerning the considered criteria. The reason for that was to gain different thoughts and perspectives of VMI and to add more depth and variety to the study. I choose one product for each supplier, even though the suppliers deliver more than one product to GGL and that an actual VMI implementation would include all these products. This was done since I believed that the quality and the easiness of interpreting both primary and secondary data were significantly higher.

4.4 Data Collection and Analysis

Data can be collected from two sorts of sources. First hand data, also known as primary data can, for example, involve interviews with individuals and focus groups. Secondary sources are data collected from other researchers and individuals, gained through business journals, company archives and internet (Sekaran, 2003). In order to grasp the present situation at GGL and to identify the potential benefits from engaging in a VMI partnership with chosen upstream suppliers, data from both primary, secondary sources, as well as theory has been collected and analyzed.

In the initiating phase of this work, literature was a great source of information in order to get familiar with theories and terminology related to the field of SCM. That is to say, through the study of theories I have gain a deeper understanding about the essence of logistics and SCM. The theoretical framework was then used as a base for the conducted interviews and field trips, as well as outlining research questions.

Face-to-face interviews have been an important source of information to observe the attitudes and expectations of what a VMI implementation would result in. To get different perspectives of issues, interviews have been conducted with employees at GGL, in various departments, as well as with the chosen suppliers taking part in this evaluation. The questionnaires that served as a base for the interviews are displayed in the appendices. The open ended questions were categorized into specific areas based on the TCO/EVA model presented in the theoretical framework.

Throughout the writing process, it has also been in both GGL's and my own interest to make continuous field visits to the Goldfields site to visualise the actual flow of information and products. For example, I have had the opportunity to both see the logistic flow of the products that I have been working with, as well as how information flow with the firm. The continuous visits throughout the writing process have played a vital role in collecting information and establishing a good relationship with GGL and the suppliers.

4.5 Quality of Research

Validity and reliability are important to consider in order to ensure the quality and trustworthiness of research (Maxwell, 1996; De Vaus, 2001). Therefore, the subsequent section will discuss these two concepts in relation to the study.

4.5.1 Validity

Maxwell (1996), states that validity should be a goal of ones scientific research. It is vital for one's credibility to thoroughly investigate all collected material and that the data from interviews are valid and correct. Validity is explained as the correctness of a description, conclusion, explanation or interpretation (Maxwell, 1996). In other words, how well the collected data have been investigated and interpreted. I have of course strived to create a thesis with high validity, where data collected have been thoroughly reviewed.

Threats towards one's validity can, however, either be of descriptive, and/or of interpretational kind (Maxwell, 1996). The former relates to how one understands what is being heard or seen. To minimize the threat to inaccurately describe information received from face-to-face interviews, an interview diary has been kept of what was being said and discussed. In addition, I also had the opportunity to reformulate the questions during the interview if the question was not understood and thus difficult to interpret. Secondly, interpretational threats were diminished by giving the respondent the opportunity to freely speak over the categories asked about. Furthermore, to enhance the accuracy of the case study, several interview occasions took place to make sure that the respondents felt at ease to give correct answers, as well as to fill in gaps and prevent eventual misunderstanding.

Additionally, it was necessary to statistically test the validity of the supposed increased (improved) service level. It has been shown from this research (through the interviews

conducted) that most of the benefits that GGL enjoys, such as, reduced stock outs, better delivery precision, better delivery reliability, shorter delivery time etc all have to do with service. It was therefore appropriate to statistically show whether indeed these benefits are true under the umbrella of service level using inventory levels as the performance metric. The probabilities of stock out for both VMI and Non VMI products were calculated over eight (8) year period and compared.

4.5.2 Reliability

In addition to the importance of data validity, De Vaus (2001) intensifies that the data collected needs to be reliable and trustworthy. A high reliability states that the result is errorless and that the measure used will give the same result in a consistent matter.

The reliability of this study is acknowledged as being high. Here, it has been important to continuously stem off with GGL and with my thesis supervisors in order to guarantee that the data collected was of high quality. In doing so, I have kept an open mind throughout the working process, as well as minimized eventual errors in collecting and interpreting the data. This is in coherence with Jacobson's (2002) qualitative model presented above. That is to say, the data collected has been compressed, rearranged, and even removed in an interactive way. For instance, a great deal of effort and time was spent on preparing the questions and discussion-topics. Thereafter, the questions were sent in advance to the interviewees' to enable them to be prepared. By defining the topics in advance, I gave the interviewees' a clear overview of what I expected before the actual meeting was taking place. Furthermore, to add to the thesis reliability, the questions have been reviewed and discussed with GGL before being sent out by e-mail to the respondents.

Lastly, I want to point out the selection of suppliers and products for this case study and how the reliability of this thesis has been affected. Even though GGL selected the suppliers, based on criteria that I presented to them, I believe that the case selection gave me the possibility to evaluate a VMI implementation at GGL. Since a case study give different perspectives when studying several relationships, in my case within the mining sector supply chain with different production, inventory, and organisational situations, two suppliers have been enough for evaluating a possible VMI implementation.

CHAPTER FIVE

EMPIRICAL FINDINGS, PRESENTATIONS AND ANALYSIS

5.1 Introduction

In this section, I will account for the findings from the interviews. The reader will be introduced to the present situation at GGL, as well as two suppliers, regarding the different areas discussed in the theoretical framework.

5.2 Supplier and Product Selection

From the interviews at GGL, it became clear that VMI is nothing that GGL want to push onto their suppliers. Instead, a VMI partnership should be worked out together in a collaborative fashion. Since GGL has over 100 Local suppliers, I found during my work, a group of seven criteria that were considered as important for GGL when selecting suppliers for a VMI evaluation. Moreover, out of these seven, the first three are very critical and cannot be compromised;

- Organisational capabilities (Financial and Technical)
- Financial stability
- Performance history
- Current relationship
- Geographical distance
- Importance of customer (GGL)
- Supplier willingness

Accordingly, these criteria have been considered to be the basis for the selection of companies. Moreover, the perception was that if suppliers possessed these criteria it would also strengthen the supplier's willingness towards a VMI implementation. Next, the current relationship between the supplier and GGL has been identified as a facilitator in VMI partnerships. Specifically, information sharing and communication must be of high quality to meet the criterion. Furthermore, the relationship should be built on trust. Even though this variable is difficult to actually measure it was still considered as important. Moreover, the importance of GGL as a customer can also be seen as significant criteria. From GGL's point of view I could see an evident concern if GGL is considered to be a small customer since it would decrease the supplier's interest. Lastly, the geographic distance is an issue to take into

account when choosing a potential VMI partner. Therefore, this criterion resulted in that the suppliers needed to be positioned in Tarkwa and at a close distance to GGL. In addition to specific supplier criteria, I also found that it would be of significant sense to consider certain product criteria. Again seven criteria were identified, which can be considered as important in order to get significant results from VMI. They are;

- Product Value
- Product Quality
- Product Volume
- Frequency of use
- Demand volatility
- Frequency of delivery
- Order lead time

Among these seven, product value, quality, volume and frequency of use are selected as of absolute importance. Firstly, the product must be of high quality, so that GGL does not need to send back the product for remaking, which would have severe impacts on GGL's production. Secondly, if the procured product is stored in big volumes, benefits in terms of a decreased number of products stored will be easier to obtain. In similarity, if the value is high the product will contribute to a high level of tied up capital. The forth criterion for selecting a specific product is that the product should be used frequently. A product that is used more often is of course more important than one that is seldom put in production.

5.3 Present Situation at GGL and Two Suppliers

Table 5.1 Overview of Selected Suppliers and Products.

	Relationship 1 Metso Minerals	Relationship 2 Sandvik Mining & Construction
Total Products sold to GGL	5	7
Chosen Product	Crusher Liners	Crushers Spares
OEM	Metso Minerals	Sandvik Mining & Construction

In order to have an effective appraisal of VMI implementation strategy I have investigated the present situation at GGL and at the two suppliers. The findings in the following section are based on a summary of conducted interviews with managers and other key personnel at GGL, Metso Minerals and Sandvik Mining and Construction

Table 5.2

Overview of Case Interviews.

Company	Contact person(s)	Position
Gold Fields Ghana Ltd.	Mr. Mike Adongo Mr Taylor	Supplies Superintendent Warehouse Manager
Metso Mineral	Mr. C. Reynolds Boamah	Operations Manager
Sandvik Mining and Construction	Mr. Francis Akuffo	Inventory Manager

5.3.1 Relationship 1 - Metso Minerals

Metso Mineral produces Crushing Lining Material for GGL. The partnership between GGL and Metso Mineral was established in 1998 and is viewed as good and open from both sides. Metso Minerals operate a consignment stock for GGL. This consignment stock is backed by an agreement which has the lists of all the products that needs to be stocked. This contract usually runs for two years and renewed depending on how both actors are satisfied with the partnership. Prices for the products have been set and fixed. A lot of work goes into the pricing to ensure that Metso Minerals do not loose as it is difficult but not impossible to change prices once the agreement has been signed. Mr. C. Reynolds Boamah hinted that factors such as Volume of stocks, expected global price changes are seriously taken into consideration.

Throughout the years, Metso Minerals has developed strong relationships with national, as well as international firms within the quarry and mining industry. Metso Mineral Ghana in total has around seven major customers within the mining sector in Ghana none of them communicate over EDI. Further, GGL is ranked as one of the top 3 most important customers. I found that the firm has a positive view on VMI partnerships. This is because the VMI concept is a well known working procedure at Metso Minerals, since the firm has

several established VMI partnerships with downstream supply chain partners. Specifically, they work from a VMI mindset with the high volume products. According to C. Reynolds Boamah (Operations, 2008-06-20), Metso Minerals have benefited from a VMI partnership with GGL in several ways. He mentioned Process and Plant Sales Ghana as one of the competitors in the industry.

5.3.1.1 Sales

Also in this relationship, I found that neither of the actors has experienced any lost sales due to, for example, poor quality, late deliveries or stock outs. In the few cases these issues have arisen, due to poor information sharing between the actors, GGL has to wait for Metso Minerals to air freight the component for them at high cost. This is not a frequent occurrence Mr. Boamah hinted as they usually keep an appreciable high volume of safety stock. Even though, this specific product is considered as a medium volume product for Metso Minerals, the importance of GGL as a customer has lead to Metso Minerals to keep the products under inspection so that their relationship with GGL is not affected C. Reynolds Boamah (Operations, 2008-06-20) stated. I also saw here, that there is contract that has been agreed upon, which could guarantee future business or minimum quantity to be purchased. C. Reynolds Boamah (Operations, 2008-06-20), stated that a termination of the partnership would be very unlikely since it would imply significant switching costs for both actors. C. Reynolds Boamaah (Operations, 2008-06-20) admits that sales have increased significantly since the inception of the partnership

5.3.1.2 Total expenses

5.3.1.2.1 Order processing Cost

GGL has production plans set for the year which is reviewed on monthly basis; this information is relayed to Metso Minerals through their monthly meetings. From this information the demand for the product is forecast and stocks subsequently up-dated. Considering the component, GGL sends an order to Metso Minerals as and when it is needed. The order processing is done when an order is sent to Metso Minerals, and Metso Mineral delivers to GGL. Furthermore, Metso Minerals has occasionally experienced changes in demand when there are technical failures of the component. Nevertheless, C. Reynolds Boamaah (Operations, 2008-06-20), stated that since Metso Minerals base their stocking solely on GGL's forecast they are not in need of further information and would, therefore, only look at the purchase orders as they come in. GGL picks the components from the stores of Metso Minerals the same day as they have their warehouse in the yard of GGL

5.3.1.2.2 Service Cost

Metso Mineral can be said to have high service levels towards GGL in terms of quality and relatively good considering quantity. I found that the former is confirmed by both partners while the latter findings are some what ambiguous. From Metso Mineral point of view, they have managed a high service levels by holding a significant amount of safety stock and by such means being able to always deliver what has been ordered. This is having a significant toll on their cash flow C. Reynolds Boamaah (Operations, 2008-06-20) hinted.

5.3.1.2.3 Transport Cost

Metso Minerals operates a consignment stock within GGL's warehouse and therefore has been able to manage transportation efficiently. This is done by a dedicated truck, which runs a specific route and full loads any time the needs arises.

5.3.1.2.4 Inventory Cost

Metso Mineral holds a significant amount of finished goods in order to hedge against demand variability and thus being flexible. In order to maintain a high service as per the agreement they keep up to three months consumption stocks, Mr. Boamah intimated. Additionally, the product is relatively expensive, which also result in extensive capital costs. However, this is a necessary act since Metso Minerals Place order on a quarterly basis, based on a 12 month forecast (C. Reynolds Boamaah Operations, 2008-06-20).

An issue that arose, in terms of consignment stock, was the control of product quality. The reason for this is that GGL, in such a relationship, would only control the quality when actually using the products and not when it is received. C. Reynolds Boamaah (Operations, 2008-06-20) stated that this always have severe impacts on their operations since it takes longer for quality errors to be detected and thus corrected. Furthermore, since all products are stored at GGL they would also have to be transported back to Metso Mineral before any problems could be solved.

I also saw that Metso Mineral do not have any strict requirements for how the product must be stored. This is because the product is produced solely of Latex Rubber. On the other hand, this product is very bulky and, therefore, it also occupies a significant area in GGL's storage facilities, which is the area where the components are stationed.

5.3.1.2.5 Production – Cost of goods sold and fixed assets

From the interview it got apparent that Metso Minerals Ghana brings in finished goods from their overseas partners and as such production cost could not be delved into.

5.3.2 Relationship 2 - Sandvik Mining and Construction

Sandvik Mining and Construction supplies crusher spares to GGL. The partnership between GGL and Sandvik Mining and Construction was established in 2000 and is viewed as good and open from both sides. Sandvik Mining and Construction also operate a consignment stock for GGL. Sandvik Mining and Construction has presence in almost all the mining companies in Ghana. They are however not connected to any of these companies by way of EDI. In his estimation Mr. Francis Akuffo (Inventory Manager) ranked GGL as their second most important customer with regard to volume of purchases. According to Mr. Francis Akuffo, Sandvik Mining and Construction have benefited from a VMI partnership with GGL in several ways. He mentioned Multi Tech as one of the competitors in the industry.

5.3.2.1 Sales

Also in this relationship, I found that neither of the actors has experienced any lost sales due to, for example, poor quality, late deliveries or stock outs. This is as result of the efficient operation of the consignment stock. Mr. Francis Akuffo (Inventory Manager) intimated that there is contract between them and GGL, which could guarantee future business or minimum quantity to be purchased and hinted that a termination of the partnership is very unlikely (Though possible) since it would imply significant switching costs for both actors. There have been few instances of stock out due to high volume of stock. Mr. Francis Akuffo who has work with Sandvik Mining and Construction for well over ten years admitted that sales have increased significantly since the inception of the partnership

5.3.2.2 Total expenses

5.3.2.2.1 Order processing

Sandvik Mining and Construction uses set maximum and minimum inventory levels to manage their stock. Stocks are replenished as soon as re-order level is reached. The lead time for air freight component (<18Kg) is 3 weeks whilst that of sea freight (<18Kg) is 10 weeks. Once an order is received from the customer (GGL) the items being requested are issued to user with waybill. At the end of the month all issued items are invoiced for payments. Mr. Akuffo hinted that they hardly encounter problems as they do not base their replenishment of

stocks on GGL's forecast. With these Max-Min inventory levels they are able to handle all unforeseen circumstances such as changes in demand and when there are technical failures of the components. GGL picks the components from the stores of Sandvik the same day as they have their warehouse in the same yard.

5.3.2.2.2 Service Cost

Sandvik Mining and Construction can be said to have high service levels towards GGL in terms of relatively good quantity with it associated cost. From Sandvik Mining and Construction point of view, they have managed a high service levels by holding a significant amount of safety stock and by such means being able to always deliver what has been ordered. This is having a significant toll on their cash flow Mr. Francis Akuffo (Inventory Manager) hinted.

5.3.2.2.3 Transport Cost

Sandvik Mining and Construction operates a consignment stock within GGL's warehouse and therefore has been able to manage transportation efficiently. This is done by a dedicated truck, which runs a specific route and full loads any time the needs arise.

5.3.2.2.4 Inventory Cost

Sandvik Mining and Construction holds a significant amount of finished goods in order to hedge against demand variability's and thus being flexible. They hold up to five months' consumption stock which's relatively expensive, this has also resulted in extensive capital costs.

I also saw that Sandvik Mining and Construction do not have any strict requirements for how the product must be stored. This is because the product is produced solely of iron. On the other hand, this product is very bulky and, therefore, it also occupies a significant area in GGL's storage facilities, which is the area where the components are stationed.

5.3.2.2.5 Production – Cost of goods sold and fixed assets

From the interview it got apparent that Sandvik Mining and Construction Ghana brings in finished goods from their overseas partners and as such production cost could not be delved into.

5.4 Analysis of the VMI Impacts in the EVA/TCO Areas

In table 5.3, the concluding remarks of the VMI effects on EVA/TCO variables are presented. The most important findings from all two relationships are outlined simultaneously without mentioning the specific firms. Furthermore, it is important to say that the table only illustrates, in general terms, which areas benefits and drawbacks can be found and how they are measured. The objective with the measurements is to indicate how and in which direction the variables will change, rather then calculating an exact number.

Table 5.3 Summary Analysis of the VMI Impacts in the EVA/TCO Areas

EVA component	TCO component	Effect on GGL	GGL benefits or drawbacks	Performance measures	Effect on supplier	Supplier benefits or drawbacks	Performance measures	Total Effect in the chain
Sales		--------	Guaranteed of future business by contracts	----------	⇧	Increase price Guaranteed of future business by contracts	Revenue per unit sold	⇧
Total expenses; other current assets	Order processing	⇕	Less need to control the supplier's deliveries improved cash flow	Time spent on monitoring Time of payment	⇕	Increased billing costs Worsen cash flow	Number of invoices sent Time of payment	⇕
	Service	⇧	Reduced costs related to service	Availability of component and inventory levels	⇧	Reduced costs related to service	Finished goods inventory levels	⇧
Inventory	Inventory	⇕	Reduced tied up capital Increased warehouse costs Development of consignment stock agreements	Warehouse Investments Time spent on formation of agreements	⇕	Reduced tied up capital Increased inventory space Development of consignment stock agreements	Finished goods inventory levels Time spent on new packaging standards Time spent on formation of agreements	⇕

5.5 Quantitative Analysis of Service Level (SL)

According to Mattsson & Jonsson (2003) there are two definitions of service level that is most common in inventory management; these are $SERV_1$ and $SERV_2$

$SERV_1$ is the definition of a service level calculated as the risk of a stock out during the interval between two following replenishments (Jonsson and Mattsson , 2003). In other words it is the probability to be able to deliver directly from inventory during an order cycle (Jonsson and Mattsson , 2003). Service level can also be defined as the part of demand that can be delivered directly from inventory. This is called $SERV_2$.

$SERV_1$ definition was employed as model to test the service levels of VMI and Non VMI products for GGL's VMI programme.

Calculation for Service Level (SL) for Non VMI product

From appendix 3

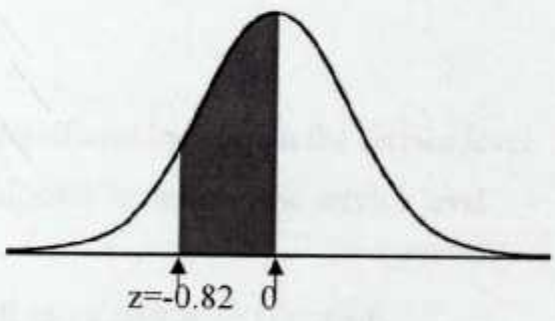
Average (Mean) Stock(S); = 4.75

Standard deviation; $\delta = 5.77$

Probability that demand will be delivered from stock P(s>0), where s is stock

Standardizing; $z = \frac{s - S}{\delta}$, s = stock =0, S=mean stock =4.75 and δ =standard deviation = 5.77, therefore $z = \frac{0 - 4.75}{5.77} = -0.82$

Thus P(z>-0.82),



Thus from normal distribution table the probability of stock not getting to zero P(z>0) for the non VMI product is 79.10%.

Calculation for Service Level (SL) for VMI product

From appendix 4

Average (Mean) Stock(S); = 8.19

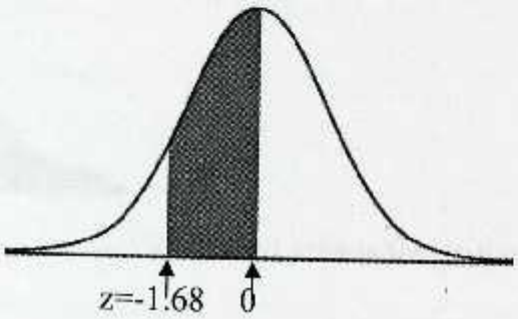
Standard deviation; $\delta = 4.88$

Probability that demand will be delivered from stock P(s>0), by $SERV_1$ definition where s, is stock

Standardizing $z = \frac{s-S}{\delta}$, s = stock=0, S=mean stock =8.19 and δ =standard deviation = 4.88,

therefore $z = \frac{0-8.19}{4.88} = -1.68$

Thus P(z>-1.68),



from normal distribution table the probability of stock not getting to zero P(z>0) is 95.35%. Thus VMI implementation has service level (SL) of 95.35%

Hypothesis Testing

Is there a rise in service level? Is the difference between 79.10% and 95.35% just chance variation, or a statistically significant increase? The increase is tested at 5% significance level.

H_0: $SL_v - SL_n = 0$, there is no significant increase in the service level

H_1: $SL_v - SL_n > 0$, there is significant increase in the service level

Where;

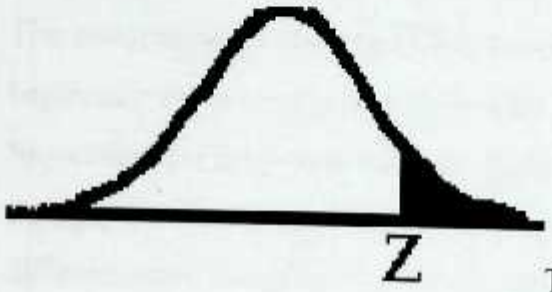
SL_v is the service level for VMI implementation (Product)

SL_n is the service level for non VMI product.

Test Statistic (TS) $z = \frac{(SLv - SLn) - 0}{\sqrt{V_v + V_n}}$, where V_v and V_n are the variances for the vendor and non vendor managed products respectively.

Referring to appendices 3&4 we have:

Thus TS $z = \frac{(95.35 - 79.10) - 0}{\sqrt{23.86 + 33.35}} = 2.15$



The shaded area is the critical region

Since the z-value (z=2.15) >1.645 hence we reject H_0 and accept H_1. Thus, there is enough evidence at 95% significance level that service level (SL) has improved significantly with the implementation of VMI partnership by GGL.

CHAPTER SIX

SUMMARY, CONCLUSIONS and RECOMMENDATIONS.

6.1 Introduction

The final chapter summarizes the major findings of this study and continue with a discussion about whether the purpose has been fulfilled or not and if the study has raised any new questions. To finalize this study a section with suggestions for future research has been elaborated.

6.2 Summary of Findings

The conclusion of this study has been made in relation to the research objectives set at the beginning of the research which aims at providing a holistic point of view regarding VMI. Moreover, the empirical findings do mostly cover the benefits of VMI implementation. Even though, we can not put any exact number, in monetary terms, on what happens within the different areas described in the set objectives, I have presented clear tendencies and directions of what is happening in these specific areas following a VMI and consignment stock implementation. Furthermore, the importance of specific supplier and product criteria when selecting a VMI partner and item has been discussed. Therefore, it can be argued that the study has resulted in the creation of new knowledge that has several managerial implications for the evaluated firm.

6.2.1 Objective One: To critically examine the benefits of VMI in the operation of Goldfields Ghana Limited, Tarkwa mine within the above framework.

The benefits of VMI implementation of VMI by GGL as identified from the study is summarized below

- Supply Chain level:
    - Lower inventory levels at total supply chain level.
    - Less overhead.
    - Increased sales.

- End-users (GGL):
  - Increased service level with regards to;
    i. Reduced stock outs:
    ii. Better delivery precision
    iii. Better delivery reliability
    iv. Shorter delivery time
  - Reduced tied-up capital
  - Reduced cost related to services.

- Suppliers (Metso Minerals & Sandvik Mining & Construction):
  - Increased sales through reduced stock outs.
  - Less redundancy.
  - Build strategic strengths through establishing strong supply chain relationships.

6.2.2 Objective two: To examine the setbacks faced by VMI and to prescribe ways to mitigate its impact. The table below provides the setbacks that were deduced from the research with its corresponding reaction to reduce its impact if not completely eradicate it.

Setbacks faced by VMI Implementation	**Remedy to mitigate the impact**
Increased dependency between the parties and increased switching costs.	Contracts should be entered into so as to fine defaulting partners
Most of the benefits are perceived to be enjoyed by end client, while the vendor does much of the work.	Expectations of all parties should be thoroughly discussed. Goals, objectives and benefits should be outlined.
Costs of technology and changing organization and Lack of trust to exchange data resulted in the ineffective implementation in one or more of the following forms: • Inventory invisibility. • Inventory imbalance.	GGL should make investment in IT a critical criterion in selecting VMI partners, to enable real time information sharing possible

Setbacks faced by VMI Implementation	Remedy to mitigate the impact
Loss of necessary shelf space as the selling party may not pay attention to inventory management, compared to competitors that are not into VMI yet.	GGL should ensure an efficient inventory management from the supplies by providing real time information. This can be achieved by the use of EDI
Increased vulnerability for non-foreseeable risks such as employee strikes, hurricanes, etc. due to lower inventory levels.	GGL Should keep a minimum safety stock

Table 6.1

6.2.3 Objective three: Prescribe ways to improve upon the operations of VMI in the mining sector.

The following steps are highly recommended for an effective and successful implementation of VMI

a) Communicate: Communicate expectations of all parties. Customers and suppliers must make the effort to sit down and discuss the goals and objectives of implementing VMI. The importance of this step cannot be overstated. Both parties' hardware and software requirements must be identified, and an understanding must be reached in terms of how both companies' systems will communicate. Then a plan for implementation must be mapped, specifically identifying each party's financial and other responsibilities.
b) Precise: Customer must commit to sharing precise information. Suppliers must have visibility into the customer's internal sales and inventory information. Without accurate data, ability to quickly meet demand will be impaired.
c) Reliable: Suppliers must ensure reliable transmission, receipt, and use of information. To facilitate step 2, the supplier must be able to guarantee that the customer's trusted information will be communicated, received, and utilized securely and thoroughly to meet the designated needs. Time should be spent during the planning phase discussing information precision and reliability.

d) Test: Sufficiently test the systems before going live. As with any new system, testing will uncover any bugs or inefficiencies and can help to avoid future headaches.

e) Process: Expect implementation to be a process and not a project. Remember that there is no on/off switch. Adjustments will have to be made as demand levels fluctuate, and no system will be perfect 100% of the time.

f) Time and Money: Plan to spend sufficient time and money to make it work. Most successful VMI systems takes two to three years (2-3) to put into operation, and cost hundreds of thousands of dollars for IT and training. Spending (or finding) the time to create a comprehensive system can be a challenge.

g) Reward: Appreciate vendors that manage the inventory well. Example: promotion to Category Captain, profit sharing schemes, etc.

6.3 Future Research

I believe it would be of great interest to investigate the possibility of Jointly Managed Inventory (JMI). In Jointly Managed Inventory a partnership between the supplier and customer is formed. This solidifies the current VMI relationship. This I believe will forestall most of the setback enumerated above.

Customer are most of the time the drivers in the implementation of VMI programme, it would therefore, be of interest to study if and how suppliers can be or should be the driver in VMI partnerships.

Again, it would be of interest to see the dynamics that will come to play in the supply chain when third-party logistics providers (3PL's) are task to manage inventory.

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Questions to Suppliers

General

How long have you been in Partnership with GGL with regards to VMI?

How is your attitude towards existing relationship with GGL?

How important/big is GGL as a customer?

How many other customers do you have and for this specific product?

Which potential benefits do you see?

Do you have any perceptions of how costs, risks, and benefits should be shared?

Is there any electronic means of sharing information such as min stock level, eg EDI?

Is there a written contract binding this partnership?

How well is today's information system working?

Sales

Have you experienced any out of stock scenarios?

If yes, how has that affected sales?

Are there any contracts that oblige you and GGL to do business over a certain period of time or purchase a specific quantity?

Total expenses

Order processing – Other current assets

Explain the order process from that an order is received to that the products are delivered to GGL.

Which costs are involved in the billing process?

Which personnel are involved in the order making process today and how much time does it take?

How is the relationship between you and GGL during the order process?

How is order changes handled and how often do they occur?

How well does the forecast match the actual need?

Do you consider the demand static or sporadic?

Do you consider the volume to be high or low?

What is the minimum deliver order quantity?

Service

How are the service levels (on time, in full) towards GGL?

Do you measure this type of performance?

If yes, how and how often?

How is unexpected situations handled, i.e. delays of supply?

Have you experienced any problems related to quality?

Which cost drivers are associated with keeping high service towards customer?

Transportation

What are your thoughts on the delivery schedule?

Would it possible for you to delivery smaller quantities more frequently?

How often do you have put in extra deliveries?

What are the reasons and costs for this?

How is the situation today regarding transport utilisation?

Inventory

Do you have any safety stock?

if yes, why is this necessary?

Where can these buffers be found?

What are the resulting costs?

How do you measure it?

How much inventory space does the specific product consume?

What are your thoughts about consignment stock?

What is the lead time for these products

Who own this space/Warehouse?

Questions to

Gold Fields Ghana Ltd.

General

Are there any alternative suppliers?

How many suppliers do you have?

How is the attitude towards existing relationship and implementing VMI?

Have GGL any perceptions of how costs and benefits should be shared?

Does GGLs overall culture support an open two-way communication with the suppliers?

How well is today's communication systems (EDI) working?

What extra costs do you think an increased information sharing would bring in terms of extended EDI use?

Is further education needed when extending the use of EDI?

Can GGL imagine any changes in work procedures or in company structure?

Production

Have you experienced any out of stock scenarios?

If yes, how has that affected production?

Has Production been affected due to poor service levels in terms of quality or quantity from the suppliers?

Are there any contracts that oblige GGL and suppliers to do business over a certain period of time or purchase a specific quantity?

Will variable/variables be altered in order to compensate for the economical disadvantages faced by the supplier in a consignment stock agreement?

Service

How are the service levels (on time, in full) towards customers and from suppliers?

Do you measure this type of performance?

If yes, how and how often?

How is unexpected situations handled, i.e. delays of supply?

Have you experienced any problems related to quality?

Which cost drivers are associated with keeping high service towards customers?

Transportation

What are the costs, or cost drivers such as volume, weight and distance, and who pays for it?

What are the delivery frequencies?

What is the time window for supplier to deliver within?

How is the situation today regarding truck loads and utilization?

How do you deal with delays and who pays for it?

How often have extra deliverics been required?

Why has this been necessary?

nventory – Current assets

Do you have any safety stock?

f yes, why is this necessary?

Where can these buffers be found?

What are the resulting costs?

How do you measure it?

Does GGL have a minimum /maximum level of inventory in stock today?

Do you have any perception of the accuracy of the current inventory?

What is the current warehouse utilisation?

Explain the inventory ownership today.

Can GGL imagine a change of ownership with a VMI implementation?

Supplier and product selection

Which criteria do you think are important when choosing a VMI partner and product?

- Organisational capabilities (Technical & Financial)
- Financial stability
- Performance history
- Current relationship
- Geographical distance
- Importance of customer (GGL)
- Supplier willingness

Which criteria do you think are important when choosing a VMI partner and product?

- Product Quality
- Product Volume
- Product Value

- Frequency of use
- Demand volatility
- End customer importance
- Frequency of delivery
- Production based on batches
- Order lead time

Please rank them in order of importance from 1 (being the most important)

Thank You

INVENTORY LEVELS FROM JAN 1999 T0 DEC2007 FOR NON VMI PRODUCT

Period by Months	Inventory Level	Period by Months	Inventory Level	Period by Months	Inventory Level	Period by Months	Inventory Level
Jan-99	0	Oct-01	0	Jul-04	13	Apr-07	12
Feb-99	0	Nov-01	0	Aug-04	10	May-07	10
Mar-99	10	Dec-01	0	Sep-04	0	Jun-07	0
Apr-99	0	Jan-02	0	Oct-04	0	Jul-07	10
May-99	0	Feb-02	0	Nov-04	0	Aug-07	0
Jun-99	10	Mar-02	0	Dec-04	10	Sep-07	14
Jul-99	4	Apr-02	6	Jan-05	6	Oct-07	0
Aug-99	0	May-02	6	Feb-05	4	Nov-07	2
Sep-99	0	Jun-02	6	Mar-05	3	Dec-07	2
Oct-99	0	Jul-02	1	Apr-05	13		
Nov-99	15	Aug-02	1	May-05	10	**Statistical Summary**	
Dec-99	7	Sep-02	1	Jun-05	5	Avg/ Mean Stock	4.75
Jan-00	7	Oct-02	0	Jul-05	5	Variance	33.3481308
Feb-00	0	Nov-02	0	Aug-05	3	Standard Deviation	5.77478405
Mar-00	10	Dec-02	0	Sep-05	0		
Apr-00	10	Jan-03	10	Oct-05	10		
May-00	5	Feb-03	2	Nov-05	6		
Jun-00	0	Mar-03	2	Dec-05	0		
Jul-00	0	Apr-03	2	Jan-06	10		
Aug-00	0	May-03	12	Feb-06	1		
Sep-00	0	Jun-03	12	Mar-06	0		
Oct-00	0	Jul-03	7	Apr-06	0		
Nov-00	0	Aug-03	4	May-06	0		
Dec-00	0	Sep-03	1	Jun-06	10		
Jan-01	25	Oct-03	11	Jul-06	5		
Feb-01	25	Nov-03	4	Aug-06	0		
Mar-01	5	Dec-03	4	Sep-06	0		
Apr-01	5	Jan-04	0	Oct-06	0		
May-01	5	Feb-04	0	Nov-06	0		
Jun-01	5	Mar-04	15	Dec-06	0		
Jul-01	5	Apr-04	15	Jan-07	20		
Aug-01	0	May-04	8	Feb-07	17		
Sep-01	0	Jun-04	3	Mar-07	16		

INVENTORY LEVELS FROM JAN 1999 T0 DEC2007 FOR VMI PRODUCT BY MESTO MINERALS

Period by Months	Inventory Level	Period by Months	Inventory Level	Period by Months	Inventory Level	Period by Months	Inventory Level
Jan-99	1	Oct-01	5	Jul-04	1	Apr-07	11
Feb-99	4	Nov-01	14	Aug-04	4	May-07	15
Mar-99	6	Dec-01	12	Sep-04	6	Jun-07	7
Apr-99	10	Jan-02	4	Oct-04	10	Jul-07	9
May-99	8	Feb-02	9	Nov-04	8	Aug-07	6
Jun-99	3	Mar-02	9	Dec-04	3	Sep-07	5
Jul-99	7	Apr-02	10	Jan-05	3	Oct-07	14
Aug-99	16	May-02	12	Feb-05	7	Nov-07	16
Sep-99	23	Jun-02	1	Mar-05	5	Dec-07	11
Oct-99	6	Jul-02	0	Apr-05	5	**Statistical Summary**	
Nov-99	12	Aug-02	15	May-05	12	Avg/Mean Stock	8.19444444
Dec-99	2	Sep-02	4	Jun-05	12	Variance	23.8590343
Jan-00	15	Oct-02	0	Jul-05	4	Standard Deviation	4.88457104
Feb-00	7	Nov-02	6	Aug-05	9		
Mar-00	7	Dec-02	8	Sep-05	9		
Apr-00	9	Jan-03	7	Oct-05	10		
May-00	10	Feb-03	16	Nov-05	12		
Jun-00	14	Mar-03	23	Dec-05	1		
Jul-00	4	Apr-03	6	Jan-06	0		
Aug-00	6	May-03	12	Feb-06	15		
Sep-00	9	Jun-03	2	Mar-06	4		
Oct-00	2	Jul-03	15	Apr-06	0		
Nov-00	7	Aug-03	7	May-06	6		
Dec-00	10	Sep-03	7	Jun-06	8		
Jan-01	9	Oct-03	9	Jul-06	14		
Feb-01	4	Nov-03	10	Aug-06	20		
Mar-01	8	Dec-03	14	Sep-06	6		
Apr-01	21	Jan-04	4	Oct-06	8		
May-01	12	Feb-04	6	Nov-06	10		
Jun-01	6	Mar-04	9	Dec-06	12		
Jul-01	3	Apr-04	2	Jan-07	5		
Aug-01	7	May-04	7	Feb-07	4		
Sep-01	5	Jun-04	10	Mar-07	10		