Industrial and Financial Economics
Master Thesis No 2002:45

A Financial Perspective of Purchasing Decisions

A CASE STUDY OF VOLVO CAR CORPORATION

Production Material Purchasing

Herbert Bagambe

ABSTRACT

The auto industry is one among the most dependants on suppliers, signifying the increased importance of purchasing decisions to auto firms. Mergers, acquisitions and new car-model projects have led to an increase in purchasing business. This has led to a large material cost turn over for auto firms. The increased size of purchasing business is a key indicator of scale economies that should be optimized in the input material supply chain. This achieves valuable synergies, combined with strategic sourcing for competitive business with suppliers. However, all these developments signify the impact of purchasing decisions for an auto firm's financial health. Thus, purchasing decisions should come after considerable financial scrutiny to achieve valuable suppliers.

This study investigated methods used by purchasers in evaluating suppliers and the basis for justifying purchasing decisions at Volvo Car Corporation from a financial standpoint. On the basis of this investigation, the study suggests a Total Value Model (TVM) to analyse and evaluate supplier-sourcing alternatives to arrive at efficient purchasing decisions from a financial point of view. The TVM is based on Volvo Car Corporation purchasing processes and tested using an illustrative purchasing example but can nevertheless be adopted and applied by other industries supported by suppliers. It comprises three independent variables, NPV cash flows to suppliers that consolidate all supplier commercial data to one value measure for comparison other than decisions based on price only.

The NPV synergies address and consolidate valuable synergies in the model framework and lastly NPV options standing for value created as a result of strategic sourcing decisions addressed through a real options approach. TVM therefore evaluates suppliers based on total value to the purchasing firm. Its simple to use, the work still remains with the purchaser and its framework perspective is very valuable to practitioners.

Keywords: Auto Industry, Financial, Net Present Value, Purchasing Decisions, Real Options, Synergies, Suppliers and Total Value

To Mum Felicity and Sofia

ACKNOWLEDGMENT

Writing this thesis has involved numerous people, whose contributions are gratefully acknowledged. I am very appreciative to all teachers of the Graduate Business School at the University of Gothenburg, whose lectures made a concrete foundation.

Am very grateful my supervisor Dr. Anders Axvarn, Professor Ted Lindlom, Professor Goran Bergendal for their suggestions and contributions that made this work a success. I cannot forget the inspiration I got from finance courses taught by Professors Clas Wihlborg of Copenhagen Business School and Dick Sweeny of Washington University. I would also like to extend special thanks to the Program Manager, Ann McKinnon for the smooth administrative support and patience throughout the study period.

Am very grateful to Volvo Car Corporation for giving me the opportunity and exposure to the business world by working with practical problems. Special thanks to the purchasers, management and other staff for the support rendered to me. In particular, I owe profound gratitude to Bill Agne my mentor at VCC for his commitment, valuable input and generous time, which is hard to forget in life. I was inspired by his analytical approach that stimulated thinking, his interest in new ways of working and learned a lot from him during the period I spent at VCC.

Lastly, I take the opportunity to thank my Mother for taking me to school, being supportive and encouraging me during the period from primary school education to university. I realise that she gave me the best direction in life. Special thanks to Kenneth Gustafson and family for introducing me to the Swedish society and continous support during this period.

Herbert Bagambe
Gothenburg, January 2003

TABLE OF CONTENTS

1   INTRODUCTION

This section presents a background to this study, and a brief presentation of the case study company, Volvo Car Corporation (VCC). I further address my research focus, purpose, limitations, potential contributions, and lastly the thesis structure.

1.1   Background

In today's highly competitive business environment, companies are continually seeking ways to keep their business performance ahead of competition. Several companies are outsourcing non-core functions as a way of lowering costs and keeping pace with industry best practices. By concentrating on core activities[1], companies are able to focus towards delivering world-class competence by hiving off peripheral activities to more suitable providers.

The auto[2] industry has not been an exception to these developments and therefore outsourcing has become an important strategic tool, in the highly competitive automotive business. This makes the industry one among the most dependent on external suppliers, with recent trends in international operations, making sourcing and purchasing decisions powerful elements in the competitiveness of auto firms.

In regard to the above discussion, it is logical to take note of purchasing decisions as vital to firm value, a justification of the purchasing function as a high value function in auto manufacturing firms. Furthermore, due to increased dependency on suppliers by auto firms, consequences of poor purchasing decisions can be severe to a firm's long-term financial health. The new business environment requires purchasing to adopt more anticipative, pro-active and assertive decision making models and methods based upon often-incomplete information. It is further observed that the increased attention to the purchasing function from top

---

[1] See (e.g. Bragg, (1998) for further discussion.

[2] Auto short for automotive.

management has resulted in the need for purchasing practitioners to justify their decisions (De Boer, 1998).

In the auto industry, the focus of this study, vast resources are spent on specific purchasing investments[3]. The issue of supplier selection carries big importance and therefore a right first-time choice of a supplier is a critical success factor towards high performance purchasing and supply. This justifies how fundamental correct purchasing decisions are much needed in auto manufacturing business.

The importance of purchasing decisions can be noticed from the above discussion and therefore, making optimal[4] decisions requires efficient methods and models to analyse and evaluate supplier options in order to achieve best value choices. This will be the main focus of this study via a case study of VCC briefly presented below.

1.2   VOLVO CAR CORPORATION

VCC is one of the automakers owned by Ford Motor Company (FMC)[5] together with other automakers of the premier automotive group (Jaguar, Landover, Lincoln and Aston Martin). It is famous for production of the Volvo brand and operates three major assembly plants, in Gothenburg and Uddevalla, Sweden and in Ghent, Belgium. The headquarters and all corporate functions are based in Gothenburg, Sweden. There are also smaller plants in Malaysia, Thailand and South Africa, serving the markets in those regions. Similar to other auto makers, the firm is supported by suppliers geographically spread over the world but the majority located in Europe. From company sources[6], it is said that VCC is in

---

3 Specific investments are assets that are uniquely tailored to a particular exchange relationship and have low salvage value outside their relationship. E.g tooling investments to suppliers in auto terms. See William, (1985) for further discussion.

4 Optimal decisions are ones that lead to high economic value decisions.

5 FMC short for Ford Motor Company.

6 More company information can be obtained from their website: www.volvocars.com

partnership with over 300 production suppliers with a material cost turnover of several billions U.S dollars. As new car models are introduced, strong sourcing processes must be in place to ensure that the material cost turnover is as efficient as possible, which necessitates choice of efficient suppliers when making global purchasing decisions. Within VCC, there are purchasing specialists responsible for:

- Supplier Identification

- Supplier assessment

- Supplier selection

- Supplier management

Given the responsibilities above, purchasers identify global suppliers, carry out capability assessments and finally perform selections in order to arrive at choices in the different aspects of cost, quality, delivery performance and others. Given the large cost turnover, it is evident that purchasing decisions represent long and large financial commitments to VCC and should be made after considerable financial scrutiny. This necessitates the use of efficient financial models and methods to achieve efficient decisions by the purchasing specialists.

1.3   Research Focus

From the background discussion made above, one among the tasks faced by purchasers is to choose efficient global suppliers in consideration of quality, technical and commercial issues. However, this study will focus on the commercial aspects regarding purchasing decisions. Commercial aspects are vital in order to achieve competitive advantage in the global market places and emphasis will be put on how purchasing decisions are made from a financial point

of view. Optimal decisions from a purchasing point of view, should lead to high value suppliers. In the global markets, suppliers differ in respect to commercial offers and to mention a few, they offer different prices, productivities, leverage and other commercial related factors. Evaluation and analysis of supplier offers are therefore vital to achieve high value business. Given the need for best business suppliers, this study will address the following question:

- How does VCC make optimal purchasing decisions from a financial point of view?

This research question intends to investigate how purchasers make supplier-sourcing decisions from an investment context and therefore this study will analyse the purchasing process as an investment process. The study will further analyse what methods and models are in use to evaluate supplier alternatives, and the basis for decision making from a financial point of view. From a financial context, optimal decisions are made on a maximum value criterion basis and to accomplish this task, the following supportive question will be used:

- What are the financial models and methods used by purchasers to evaluate and choose suppliers from the available alternatives?

Findings regarding the current methods used by purchasers to achieve efficient supplier choices will be a basis for suggestion of alternative methods and models, vital for continuous process improvement, addressed through the following supportive question:

- What alternative models and methods can be used in evaluation and choice of optimal suppliers to support continuous process improvement?

How does VCC make optimal purchasing and sourcing decisions from a financial point of view?	→	What methods and models are used to compare supplier options? How are decisions justified from a financial point of view?

What alternative models and methods can be used in evaluation and choice of Suppliers?.
•To support continuous process improvement ?
•To justify purchasing decisions
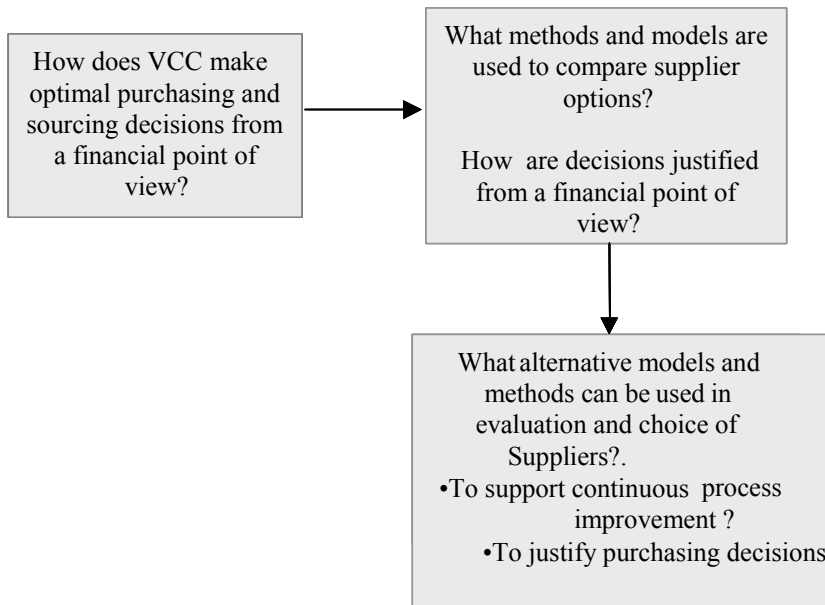
Figure 1, Overview of research focus

1.4   Purpose

First, the purpose of this thesis is to make an empirical study of the methods and models used by purchasing specialists at VCC to make supplier-sourcing decisions from a financial point of view. The aim is to achieve answers to research question one.

Secondly, based on empirical findings, a theoretical framework has been built and will be used to analyse the available financial methods from a purchasing point of view. This will provide a basis for suggesting an alternative model for financial analysis of suppliers, built around the current purchasing process that can be used to justify purchasing decisions.

1.5   Limitations

▪ This study will focus on the financial evaluation of suppliers and will assume all other factors that are relevant for making for purchasing decisions constant. E.g. Quality, Technical and Supplier performance criteria.

▪ The study findings will be based on VCC and are not general findings of purchasing practices with other firms but the model can be used by other industries. Furthermore, the study will be limited in presenting company information that is sensitive to disclosure.

1.6   Potential Study Contribution

▪ The study aims at contributing to the financial quality of purchasing decisions within VCC.

▪ Highlight the importance of financial evaluation of suppliers to the purchasing process.

1.7   Thesis structure

```
┌─────────────────────────────────┐
│      Chapter 1: Introduction    │
│    Presents the research focus, │
│   purpose, potential contribution│
│         and limitations.        │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│     Chapter 2: Methodology      │
│    Methods and approach used to │
│     achieve the purpose of this │
│        thesis are discussed.    │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│    Chapter 3: Findings from VCC │  ⎫
│   Presents and describes empirical│  ⎬ Purpose 1
│     findings from VCC to achieve│  ⎭
│           purpose 1.            │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│   Chapter 4: Theoretical Supports│
│    Presents financial, purchasing│
│     and supply chain theoretical│
│            framework            │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│   Chapter 5: Total Value Model  │  ⎫
│              (TVM)              │  ⎬ Purpose 2
│    Based on chapter 3 and 4, TVM│  ⎭
│     is presented and suggested for│
│       evaluating suppliers from a│
│        financial point view     │
└─────────────────────────────────┘
                 ↓
┌─────────────────────────────────┐
│ Chapter 6: Conclusion and Recommendations│
└─────────────────────────────────┘
```
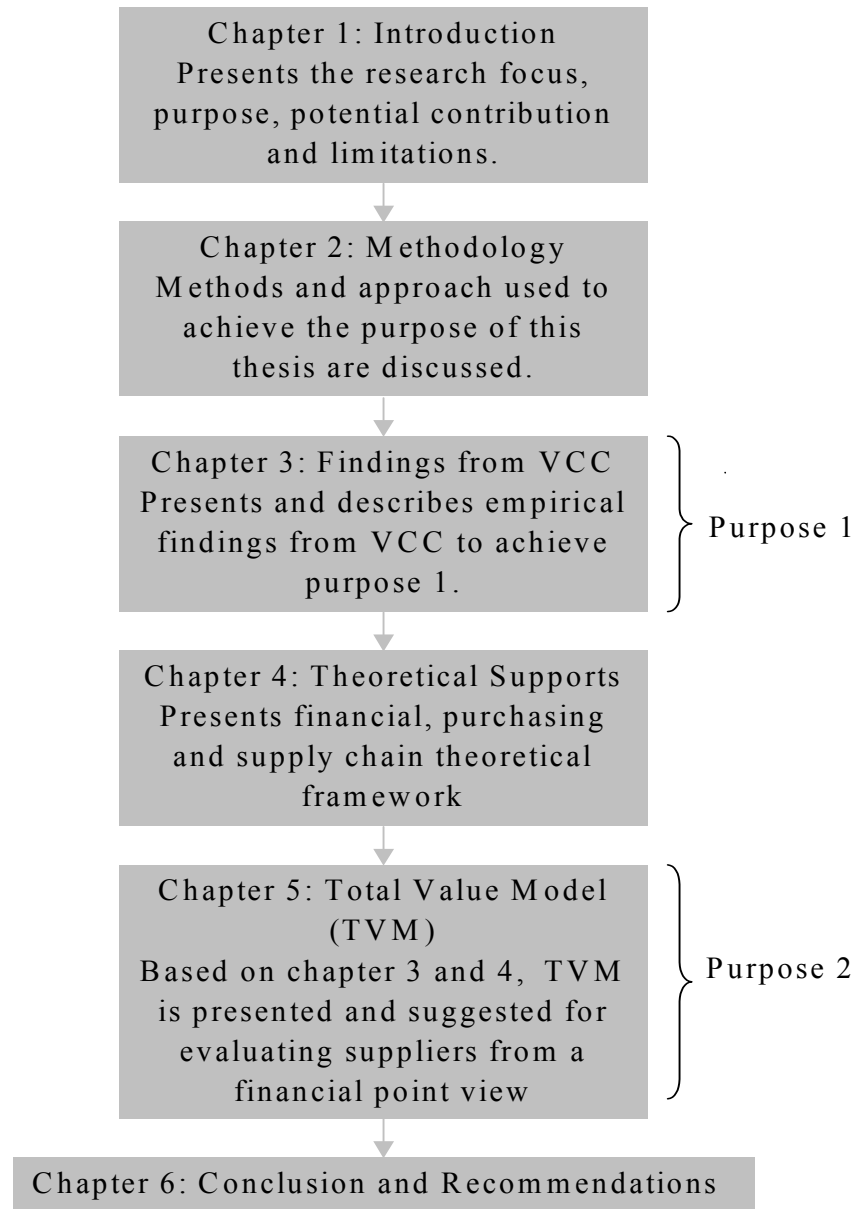
Figure 2, Thesis structure

7

2   METHODOLOGY

Research methods used to achieve the purpose of this thesis are explained and motivated in this chapter. It starts with a presentation of the approach used followed by methods used to collect and analyse data.

2.1   Approach

A case study[7] approach was adopted and is the purchasing function of VCC. The motivations for this approach are presented below:

The approach was chosen due to the nature of the research focus, which is a vital factor in choosing a relevant approach. The purpose of this thesis is to make an empirical study leading to findings of methods and models used by purchasers to evaluate and justify purchasing decisions and on that basis, to come up with an alternative suggestion of a model for financial evaluation of supplier alternatives. VCC outsources input materials and was an appropriate case to consider for this study. To achieve this purpose, there was a need to focus on the respective function responsible for purchasing operations, which is a reasonable justification for using this approach.

This approach provides access to multiple sources of information regarding methods used by purchasers at VCC. A purchasing process exists and purchasers play a big role in terms of identification, evaluation and choice of suppliers. From this point of view, it was possible to come up with empirical findings regarding the research questions.

Lastly, the approach gives a holistic view while examining real-business purchasing practices, which gives a deeper understanding of the purchasing process and area. Nevertheless the results of this thesis can be applied to other purchasing circumstances, despite choosing VCC as case study.

---

[7] See e.g Copper, (1998) and Sanders (2000) for further discussion of the case study approach

2.2 Methods Used

To achieve the purpose of this thesis, both qualitative and quantitative methods were used and are relevant given the nature of the purchasing process in VCC that combines both methods as inputs to the decision-making process. A qualitative description was made regarding the purchasing process and a quantitative approach used to illustrate the suggested model through a purchasing case example.

Data collection: The data collection techniques used were conducting interviews, participation and internal electronic sources. This was to support understanding of the supplier sourcing process and grounds for decision making from a financial point of view.

Interviews
I carried out interviews using interview guide questions attached in the appendix. The questions were tailored to the research focus, with the aim of achieving the purpose of this study. I made personal interviews with purchasers at VCC who hold primary and leading responsibilities in the purchasing process. The type of questions presented in the interview guide required explanations and illustrations, discussion of the answers, which was vital to achieve accuracy and detailed knowledge regarding the purchasing field.

Participation
Participation was part of the research process through attending purchasing process meetings and observing the decision making process. These were meetings regarding supplier-sourcing decisions and focused on supplier assessment and choice. Within meetings purchasers justified their recommendations and choices. The aim was to observe the decision making process and derive own insights and findings regarding financial considerations in the process.

Electronic methods: With the use of the company's intranet system, I got access to the BMS[8]. The Business Management System is an electronic information database that contains details of doing purchasing business. This system was vital and saved time in terms of fast means of information.

Selection of Literature

The theoretical framework chosen to achieve the purpose of this thesis was that of finance investment, purchasing and supply chain management theory. The three categories of literature were integrated together to give a firm background and understanding of the thesis areas. Furthermore arguments based on the theoretical framework were a basis for suggesting an alternative model for financial evaluation of supplier sourcing alternatives.

Reliability and Validity

Reliability of the study can be explained by the high response from purchasers and my exposure to VCC's purchasing process. This gives a holistic overview of the process by driving my understanding of how the process works. Validity can be explained by the results of this thesis, which is a Total Value Model (TVM) that has been illustrated through a real life purchasing case example to show application and model results.

---

[8] BMS is short for business management system

3   FINDINGS FROM VCC

This section intends to present empirical findings regarding the question:
"What are the financial models and methods used by purchasers to evaluate and justify choice of suppliers from available alternatives?" this is in line with the research focus of this thesis. A brief overview of the sourcing process is presented and lastly methods used by purchasing specialists to evaluate supplier-sourcing decisions.

3.1   Supplier Identification

Primarily Purchasers[9] are responsible for identifying and nominating suppliers, when the need for material input is identified. According to interviews with purchasers, they normally refer to the existing supply base at both VCC and FMC and if no suppliers are identified, they refer to the global auto supplier market. A bidder list is created and an RFI[10] is sent to the identified suppliers. At this stage, purchasing specialists analyse supplier information and evaluate potential of the supplier alternatives, which proceeds with organizing cross-functional purchasing teams[11.] At this moment, a plan for implementing a SEM[12] is made for the potential suppliers. The aim is to short list from the bidder list and makes comparison work between alternatives easier, with fewer supplier alternatives.

---

9 Primary purchasers are the ones responsible for running a purchasing case and have the task to analyze suppliers and their characteristics.

10 RFI is short for Request for information and gives details of technical issues, commercial data,financial health and general business ability of suppliers .

11 Cross-functional teams consist of specialists in quality, engineering and design, commercial and other relevant functions to the purchasing case.

12 SEM is short for supplier evaluation model.

3.2   The Supplier Evaluation Model

The supplier evaluation model is a framework that puts together vital detailed information regarding potential suppliers. It is important to have a brief discussion of this model and what it entails, before proceeding with findings regarding financial methods used for supplier analysis. It is a vital step in evaluating and analysing potential supplier alternatives and a sketch of basic evaluation factors has been presented in figure 3. According to purchasing specialists interviewed, recommended suppliers to be considered for further consideration should score more than ▮▮▮ (confidential figure) according to VCC purchasing procedures.

The model serves the following purposes:

▪ Acts as a basis for evaluation of potential suppliers and an audit tool for existing suppliers.

▪ Gives detailed knowledge to purchasers about each supplier. E.g. Commercial, technical, financial, quality and other.

▪ Acts as an improvement tool for developing suppliers.

▪ Is supportive in facts based decision-making.

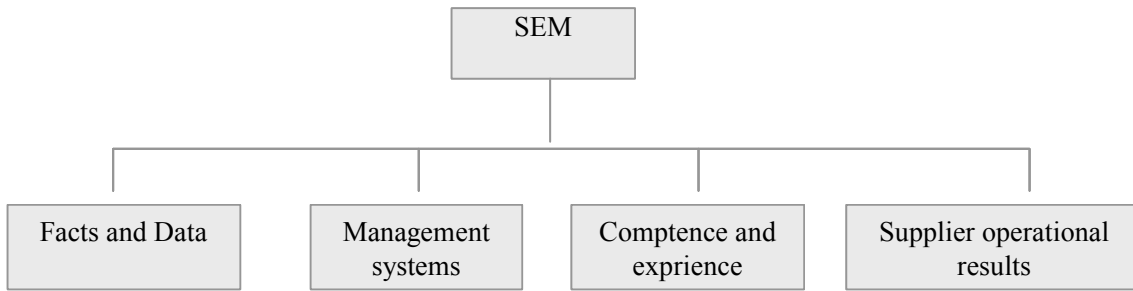▪ Is a vital tool for continuous follow up process of suppliers.

```
                              ┌──────────────┐
                              │     SEM      │
                              └──────┬───────┘
          ┌──────────────┬──────────┼──────────────┬──────────────┐
   ┌──────────────┐ ┌──────────────┐ ┌──────────────┐ ┌──────────────────┐
   │ Facts and Data│ │  Management   │ │ Comptence and │ │Supplier operational│
   │              │ │   systems     │ │  exprience    │ │     results       │
   └──────────────┘ └──────────────┘ └──────────────┘ └──────────────────┘
```

Figure 3, the supplier evaluation model: Source, VCC

3.3   Brief Description of the Sourcing Process

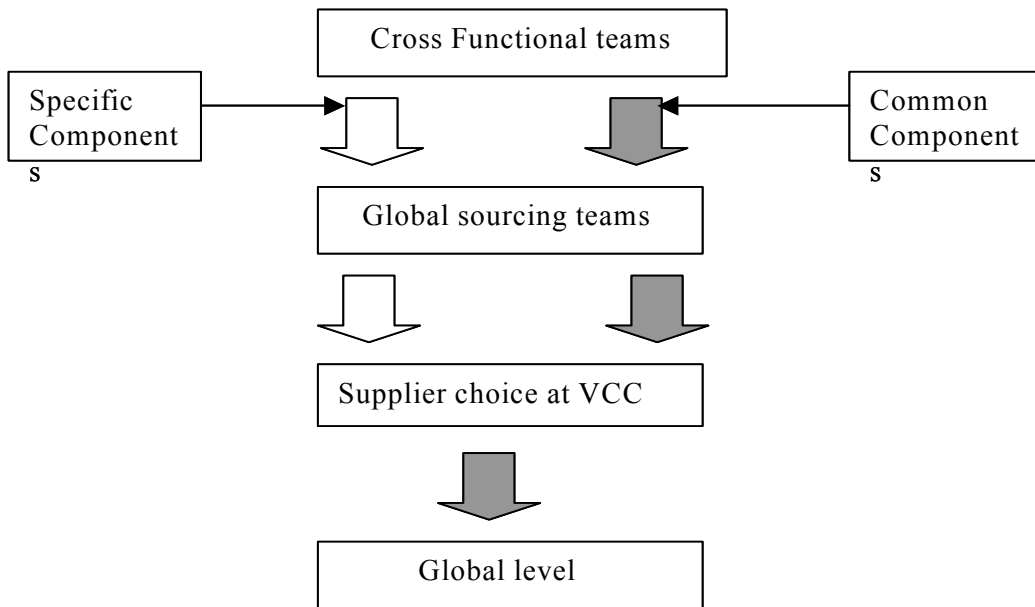The sourcing process at VCC can be summarized in the figure below.

```
                    ┌──────────────────────────┐
                    │  Cross Functional teams   │
                    └──────────────────────────┘
┌──────────────┐        ⇩            ⇩         ┌──────────────┐
│ Specific     │ ──────►                ◄───── │ Common       │
│ Component    │                               │ Component    │
│ s            │                               │ s            │
└──────────────┘    ┌──────────────────────────┐
                    │  Global sourcing teams    │
                    └──────────────────────────┘
                         ⇩            ⇩
                    ┌──────────────────────────┐
                    │  Supplier choice at VCC   │
                    └──────────────────────────┘
                                  ⇩
                    ┌──────────────────────────┐
                    │      Global level         │
                    └──────────────────────────┘
```

Figure 4, VCC sourcing process
Source: VCC

Cross functional teams: Cross-functional teams are formed in order to evaluate and discuss supplier alternatives in the different perspectives of quality, engineering, design and commercial factors in respect to commodity to be purchased. The intention is a team contribution to the different critical factors for supplier selection mentioned above.

Global sourcing teams: Global sourcing teams are organized to evaluate and analyse suppliers at a global level with other brands of the FMC family of which the purchaser has a leading role. The teams are vital in scrutinizing supplier alternatives for possible commonality between components and driving achievement of valuable synergies in the supply chain. The aim is optimising purchasing economies of scale, vital at a time when both VCC and FMC are working towards integrated purchasing operations.

Supplier choice at VCC: Final supplier choice is made at VCC if the component sourced is specific and not common in other FMC brands. The purchaser has a leading role to convince purchasing management of the supplier choice and this should be supported by facts and data. He further plays a vital role in terms of a sourcing approach from the supplier.

Global management level, decision-making: Final decisions taken at global level with other brands for common components, of which the purchaser plays a supportive role in terms of recommending potential suppliers. The intention is to optimise purchasing economies of scale between VCC and the FMC group.

3.3.1 Purchasing Economies of Scale

One of the findings from the VCC sourcing process is that it puts into consideration, the presence of scale economies in purchasing operations. According to interviews with management, both VCC and other FMC group members are working towards integrated purchasing operations. This justifies the fact that VCC should optimise valuable synergies that exist as a result of scale

16

economies in the supply chain, in form of reduced purchasing costs. The implication is that, there are synergies that should be optimised and integration of purchasing operations is aimed at accelerating cost savings in the supply chain.

3.3.2 Commercial Facts for Supplier Selection and Choice

Findings from interviews indicated the following commercial factors as vital for choice of a supplier and the next section will proceed with how these factors are analysed to achieve high value business with suppliers.

Piece price and landed cost: The piece price[13] was found to be an important factor towards choice of a supplier from all purchasers interviewed. Suppliers with lower piece prices stand a higher competitive advantage over suppliers with higher prices. Given the piece price, a landed cost[14] is calculated which is the price to line in production. Suppliers are then compared on the basis of price landed cost. Due to the fact that suppliers are global, there are differences in landed prices; price becomes a critical determinant of supplier competitiveness.

Tooling and other investment costs: When supplier choices are made and before start of production, there are fixed costs involved, which are both internal[15] and external[16]. VCC invests at supplier sites so that they can have the necessary tools to manufacture the required components. Suppliers need to provide quotations for required initial investment costs, some of which are sunk[17]costs due to investment in specific assets. These investment costs are a vital factor when analysing and

---

13 Piece price is the cost per unit of part or system to be purchased.

14 Landed cost is the sum of part price, freight, insurance, packing material and other costs. Its given by the following expression; Landed = Price to line in production.

15 Internal costs are costs paid internally to implement a new supplier like validation costs, tests, specification, manufacturing and other.

16 External costs are paid to the supplier like engineering, tooling, packing and other.

17 Sunk costs –Costs incurred on specific assets.

evaluating total business with a supplier, and affect the competitiveness of suppliers.

Productivity: In regard to productivity, suppliers should have a high competence and capability to reduce costs over the lifetime of the purchasing project for a given component. Suppliers should provide competitive productivity plans for VCC to achieve efficient[18] purchasing business. Cost reduction activities and methods[19] should be in place regarding manufacturing process, which is an indicator of supplier efficiency. Most purchasers interviewed agreed to the fact that productivity was a critical factor towards recommending and choice of supplier alternatives.

Leverage: Leverage from this point of view refers to reductions in price as a result of increased purchasing volumes. Leverage offers differ among suppliers depending on negotiation results achieved by the purchaser. According to interviews with purchasers, leverage offers should be competitive among suppliers.

Commercial Negotiations: The discussion above presented commercial factors that are vital for choice of suppliers. However, for competitive business with suppliers, negotiations are made initially before choice and annually after choice of suppliers. The purchaser leads negotiations and the aim is to achieve high value business from suppliers. This gives a further implication of the purchaser's role as a lead negotiator in regard to commercial factors. Further more, with the above commercial factors discussed above, the next concern is to find methods and models used to analyse and evaluate the different factors discussed above.

---

18 When suppliers are efficient in their operational processes, VCC attains good business from them.

19 Methods such as overall equipment efficiency and cost split up (value analysis) can be used to evaluate and reduce costs.

3.4 Methods Used to Analyse Commercial Factors and Data

So far the task has been to present an overview of the sourcing process and commercial factors used to support purchasing decisions. At this moment, it is vital to present findings of the methods used by purchasing specialists to analyse and evaluate commercial data, in order to achieve optimal purchasing decisions. I will proceed with findings to the questions below:

- What are the financial models and methods used by purchasers to evaluate and choose suppliers from the available alternatives?

- What financial methods and models are used to consolidate all the commercial factors and data to one measure for comparison purposes? How do purchasers compare total purchasing business with suppliers?

Answers to the questions above were attained through interviews with purchasers and purchasing management sources within VCC. The findings are concisely presented below:

3.4.1 Findings from Purchasers

Interviews[20] were administered to a representative sample of purchasers in the form of both informal and formal interviews. The formal interviews were based on a number of guide questions with the intention of providing background information to the supplier selection process and decision-making. Findings indicated methods such as price-based comparison, cash flow based comparison and investment payback as methods used by purchasers to compare supplier alternatives.

---

20 Interview guide questions are attached at the end in appendix 1.

19

Price based comparisons: Findings from purchasing specialists indicated that price based comparison was a basic tool in terms of comparing supplier alternatives. Price is a strong commercial variable in auto industry purchasing given the fact that it is a basis for cost estimations, analysis of supplier offers and a reference factor for negotiations. Therefore using price for comparison is an easier way and speeds up the process. The following answers were received in regard to how purchasers found best prices:

- Prices identified during market research

- Prices reasonable for previous purchases

- Price estimates as a result of value analysis

- Personal knowledge of item prices

- Other reasonable bases in comparison to the target price[21.]

- Current price lists, catalogues, or advertised prices all depending on the item to be purchased.

The implication from the price-based comparison was that suppliers with lower prices have a higher competitive advantage over suppliers with higher prices. According to interviews, it was easier to make comparisons based on quoted prices by suppliers. Given the fact that price is a critical factor in choosing a supplier, there is need for consideration of other commercial factors for comparison purposes to have a consolidated comparison measure.

---

21 Target price is the price set by product development for an item before project start.

Cash flow based comparison: Purchasers interviewed indicated that, if the best price suppliers were found and recommended, cash flow[22] based analysis for the lifetime of the purchasing project is a basic tool to compare purchasing business with suppliers. In this case, purchasers compare supplier alternatives based on yearly cost for the lifetime of the purchasing project and alternatives with the least yearly costs to VCC, are considered more competitive. The method is very vital mainly when purchasers have to analyse price results and impact of negotiation results.

Investment Payback: Through interviews, some purchasers indicated that they used the payback method for comparison purposes. This method was more used to analyse initial investment with suppliers and finding a payback period. In this case suppliers are evaluated on the basis of shorter payback on investment, implying best business supplier alternative.

NPV[23] of total business with suppliers: In regard to the above method, suppliers are compared in respect to one single value metric, which brings together all commercial data from suppliers (for example price, annual cash flows, investment costs, productivity, leverage offers and others), to one comparable economic value metric. The NPV was not a popular method for analysing and evaluating potential suppliers among purchasers interviewed.

Findings from the final supplier choice phase indicated that all commercial factors discussed were vital and critical for decision-making in the final choice phase. However, no method was used to consolidate all the commercial factors to one metric for comparison and decision making purposes. Given the fact that a split up of the commercial factors is necessary for critical financial analysis, a consolidated

---

22 Cash flows in this case are the yearly costs incurred by VCC to suppliers. Yearly cost = Quantity x landed cost.

23 NPV – Net Present Value

metric bringing together all commercial data is necessary, given the fact that suppliers compete in the different commercial aspects. Lastly, consolidation of commercial data for comparison purposes of supplier alternatives enables having a holistic view of the total supplier business with VCC.

Business Management System: In order to explore more findings regarding financial methods for supplier analysis and evaluation used by purchasers, I conducted a search in the business management system. The system contains details for doing purchasing business within VCC. This was to gather information regarding purchasing procedures and business methods used for analysing and evaluating purchasing business.

3.5   Implication of the Findings

Findings from purchasers interviewed indicated that each used a different approach. All approaches mentioned are very vital to the purchasing process as per the discussions above. Nevertheless, there is an opportunity to strengthen and improve existing approaches to achieve continuous process improvement. The next section will discuss methods presented in financial theory for investment evaluation, and how they can be used from a purchasing point of view. Lastly, at the end of the section, the result will be choosing a suitable method among them, after a theoretical discussion of merits and shortcomings from a purchasing point of view.

4 THEORETICAL SUPPORT

This section presents a theoretical background to the research questions addressed by this thesis. The idea is not to introduce theoretical concepts and topics in their entire form but rather a background understanding. The first part will discuss previous research regarding models and methods in the area of supplier selection, financial methods for investment evaluation discussed from a purchasing point of view, real option theory and lastly the kraljic-purchasing portfolio matrix. All theories discussed are relevant to achieving the purpose of this thesis.

4.1 Previous Research Work Regarding Supplier Selection

Purchasing decisions in the auto industry involve selection and choice of suitable suppliers for duration of the purchasing period rather than securing today's material inputs. To a certain extent some non-production material is purchased from on spot best supplier alternatives. To understand and have a background to the supplier selection area, I endeavoured to review some of the supplier selection methods reported in past studies. The methods reviewed, for example (Total cost of ownership, Categorical methods, Cluster analysis and Cost based reasoning), are attached in appendix 2 for interested readers. The aim is to analyse their use as a basis for making purchasing decisions and how they address the financial aspects in the supplier selection process. Lastly, the review intended to analyse how the methods addressed the purchasing process in a financial investment context.

4.1.1 Remarks from Previous Research

The deduction from previous research is that the models are market-based methods and do not give financial aspects considerable treatment in the purchasing process. Although they address price and cost as vital factors, the purchasing process needs to be treated as an investment process from a financial point of view. There is need for value analysis in a financial context by purchasers to

justify long-term auto purchasing decisions. It is further noted that most of the models address spot market best alternatives and yet the auto industry is Characterized by long-term suppliers, ensuring material items in the long run depending on a lifetime of car model projects. According to Copeland and Vladimir, (2000), investment decisions come under considerable financial scrutiny, which applies to purchasing decisions, since they are investments in a firm's operational inputs. It is vital to evaluate the long run financial impact of purchasing decisions, a fact that is not addressed in previous research models. Financial models that make use of value-based analysis of alternatives can be of vital use in aiding purchasers to choose most valuable suppliers from a financial point of view. To fulfil the purpose of this thesis, it is worthy discussing investment evaluation methods presented in financial theory and their application in a purchasing situation.

4.2   Purchasing as an Investment

Making purchasing decisions in terms of best value supplier alternative from a financial point of view, is similar to other investment decisions, despite the fact that auto manufacturing purchasing puts into consideration quality, technology, capability and the global nature of suppliers.

In the auto industry, purchasers are frequently faced with long term investment decisions in form of material component purchasing. They have a vital role to play in terms of identifying, evaluating and contributing to choice of suppliers. Further more, purchasing involves investment in fixed assets, which are highly specialized, sometimes immobile, and usually of greater risk than holding cash. There are instances where the liquidation value will be very low if the investment in a supplier is unattractive. It further involves commitment of cash in exchange for material components to support production operations, implying future financial commitments. The above discussion signifies the need to treat the sourcing and purchasing process as an investment process. This is due to the fact

that financial commitments and benefits by the purchasing firm extend beyond the current year. This indicates that selection of efficient suppliers is cardinal in efforts to add value to the firm.

4.2.1 Implications

From the above discussion, the message is that financial methods and techniques are an appropriate tool for purchasing investments to achieve efficient suppliers. From the point of view of financial theory (see e.g. Van Horne J.C, 1995), investments should be made on the basis of a value-maximizing criterion[24], an argument that that supports optimal supplier choices since they are investment choices. Purchasers use available commercial information and data from suppliers, to evaluate the attractiveness of the various supplier alternatives. This implies that financial investment methods can be applied in the purchasing process to analyse purchasing business with suppliers. The above implications, lead to a discussion of alternative methods for investment evaluation and their application in a purchasing context.

4.3   Methods used for Financial Analysis of Investments

Financial theory (see e.g. Brigham, 1995; Wachowicz and Van Horne, 1995; Pike and Neale, 1999) presents alternative methods for investment evaluation and choice. Others (e.g. Klammer, 1972; Schall, Sundem and Geijsbeek, 1978; and Graham and Harvey, 2001) have concentrated on research regarding adoption of the techniques by business practitioners in industry. This thesis will focus on the application of these techniques to purchasing investments, given a justified basis for their application. The four most popular alternative methods used in evaluation and selection of investments are presented below:

- Payback rule method

---

24 Value maximization criteria - choice of investments on highest value basis.

- Accounting rate of return

Discounted cash flow techniques (DCF)[25]

- Internal rate of return (IRR)

- Net present value (NPV)

In financial theory, both the IRR and NPV are referred to as DCF tools and aim at directing a firm's resources to those activities that provide the highest economic value. A discussion of the methods presented above, is worthwhile at this stage from a purchasing point of view.

4.3.1 Payback Method

The pay back method evaluates investments in terms of the length of time taken for the net cash inflow from an investment to cover the initial costs of the investment[26]. Financial theory presents the advantages and disadvantages of the payback method and this thesis intends to have the discussion from a purchasing point of view. Purchasing in the auto industry, like any other investment involves initial investment costs (e.g. tooling costs at supplier sites) and cash out flows to suppliers, over a lifetime of the purchasing period. Therefore using the payback has the following shortcomings when used to analyse and evaluate supplier alternatives:

- Using the payback method ignores the time value of money and simply adds cash flows without regard to the timing of these flows.

---

25 DCF stands for discounted cash flow techniques, which consider the time value for money . (They are   NPV and IRR methods).

26 See (e.g. Wachowicz and Van Horne, (1995) for further discussion of the payback method.

26

In the above case, the maximum acceptable payback period that serves as the cut-off standard would be purely a subjective choice. In the case of purchasing investments, neglecting the time value of money diminishes firm value in the long run.

▪ The method fails to consider cash flows occurring after expiration of the payback period.

In reference to the above point, the method cannot be regarded as an accurate measure of profitability for big investments. From a purchasing point of view, the method leads to neglect of profitable suppliers in the long run. Finally, while being an inappropriate measure of profitability for big investments, the payback gives a rough indication of the liquidity of an investment. Many business practitioners use it as a crude measure of investment risk and find it easier to apply, given the fact that no discount rate is needed when it is applied. From a purchasing point of view, other approaches can be used to evaluate suppliers and capture business risks to reach efficient decisions. Lastly, the method can be used as a supplement to other methods discussed below:

4.3.2 Accounting Rate of Return Method

Financial theory defines the ARR as the percentage of average income from the investment to total investment costs. It is expressed by the equation below:

$$\text{ARR} = \frac{AI}{AIn}$$

Equation 1, Accounting rate of return
Source: Wachowicz & Van Horne, 1995
An equation where
AI is the average annual income from an investment
AI $_n$ is average investment costs.

27

ARR stands for the accounting rate of return

The method has the following shortcomings in relation to purchasing investments:

▪ The method does not put into consideration the time value of money and ignores cash flows after investment period as discussed with the payback.

▪ Its application by purchasing practitioners in evaluating different supplier alternatives would need availability of accounting information in order to derive expected average income from purchasing investments. This makes it complex to the purchaser in the auto industry who has to take independent decisions with less of accounting information.

4.3.3 Internal Rate of Return

Two methods have been discussed so far, regarding their use and shortcomings in relation to purchasing investments. Financial theory further presents DCF methods which are the IRR and NPV that provide a more critical basis for evaluating and selecting investments, of which purchasing is inclusive[27]. From theory, the IRR of an investment is defined as the discount rate that equates the present value of the expected net cash flows with the initial cash outflow. The IRR puts into consideration differences in the timing of cash flows for various investments by discounting them to their present values. It is expressed by the following equation:

$$I = \sum_{t=0}^{T} \frac{C_t}{(1+r)^t}$$

Equation 2, Internal Rate of Return
Source: Wachowicz & Van Horne, 1995

---

[27] see (e.g. Wachowicz & Van Horne, 1995; Pike & Neale, 1999;) for further discussion.

In this equation

$C_t =$ Forecasted cash outflows

$-I =$ Investment costs

$t =$ Planned duration of the purchasing project.

$r =$ IRR

The acceptance criterion used with the method is to compare the IRR to a required rate of return or the hurdle rate. From a purchasing point of view, if the IRR exceeds the hurdle rate, a supplier is accepted and if not rejected.

The IRR has the Following Shortcomings from a Purchasing Point of View:

▪ Purchasing is characterized by negative cash outflows and calculating for the IRR would yield a big IRR, which is not comparable. Such an IRR is not suitable measure for comparing supplier alternatives thus not compatible in terms of simplicity to the purchaser.

▪ IRR yields multiple rates, and a necessary but not sufficient condition for this occurrence, is if the cash flow stream changes sign from minus to plus.

Despite the above shortcomings, practitioners use the IRR method, mainly because it's easier to visualize and interpret than if they do it with the NPV. They donot have to initially specify a required rate of return in the calculations and therefore, the method permits a more satisfying comparison of projects.

Furthermore, practitioners feel more comfortable with a return measure as opposed to other absolute measures like the NPV. As long as the investment is not confronted with multiple sign changes in the cash flow stream, the IRR method may be used with reasonable confidence.

4.3.4 Net Present Value Method

Like the IRR, NPV is a DCF approach to investment evaluation. The NPV[28] of an investment is the present value of the expected net cash flows less the investment's initial cash outflow. NPV works in several investment situations, with limited shortcomings compared to the other methods, although both the NPV and IRR would yield the same results. Here follows a discussion of its advantages from a purchasing point of view:

▪ In financial theory, method gives a direct measure of the dollar benefit on a present value basis of investment projects. It is therefore regarded as the best single measure of profitability, supporting its use in evaluating investments. From a purchasing point of view, highest value suppliers will be chosen on a NPV basis.

▪ The method takes into account the time value of money[29] when assessing investment decisions, which should apply to those of a purchasing nature.

Purchasing decisions made today, involve future financial commitments by the firm to its suppliers. Therefore, using NPV would critically evaluate suppliers based on the timing of cash flows rather than being dependent on the quoted price for decision making. Though the price variable is very important in deciding on the best alternative in the auto industry, there is a need for assessing best alternatives in value terms to the firm[30].

▪ The method is vital in capturing investment risks. Many investment decisions are uncertain and with the use of a discount rate, uncertainties can be accounted for, by use of a discount rate.

---

28 The NPV expression is presented in chapter 5 .

29 A dollar today is more than a dollar tomorrow.

30 Selecting alternatives based on highest economic value.

From a purchasing point of view, the purchasing firm forecasts required volumes and obtains price quotes from suppliers. The result is an estimate of forecasted cash flows to suppliers for a planned purchasing period. The appropriate[31] discount rate can be applied, which offers explicit treatment of risks involved when a firm commits financial capital in purchasing investments to suppliers. Lastly, using a discount rate eliminates judgmental risk analysis and allows use of quantifiable measures. From the above discussion, there is a reasonable basis for using NPV analysis in a purchasing context. The quantification of purchasing opportunities would allow easy ranking of suppliers in terms of value contribution to firm. The discussion above gives outright reasons to recommending the use of the NPV method as a financial tool for evaluating purchasing investments.

Moreover, results from the method can be supportive to a purchasing practitioner in the evaluation and assessment stage and further to the choice stage in the supplier selection process. The extension of real option analysis to the NPV method provides a thorough framework for investment evaluation.

The method has the following shortcomings: In financial theory[32], the NPV has been recognized as a superior technique in investment valuation. While we have discussed the advantages of using NPV from a purchasing point of view, financial theory argues that it overlooks important strategic concerns about future uncertainty and flexibility to respond to situations that differ from those that were expected.

▪ To be more particular, DCF techniques ignore the value of operating flexibility that give management, the option to revise decisions while investments are underway. The point is that future opportunities generated by current investments

---

31 An appropriate discount rate could for example be the WACC. WACC – Weighted average cost of capital.

32 See (e.g. Copeland and Vladimir, (2000), Kulatilaka and Amram, (1999), Trigeorgis, (1995) for further discussion.

are clearly very valuable. The extension of a real option approach to the NPV framework would provide for an adjusted valuation, accounting for incremental value from strategic flexibility.

In conclusion, the methods discussed and their shortcomings from a purchasing point of view, the NPV method stands as most suitable for analysing supplier alternatives to achieve optimal purchasing decisions.

4.4   Real Options

This section introduces real option theory, given its relevance in accounting for strategic value embedded in investment opportunities, of which purchasing investments are inclusive. Examples will be used to drive the intuition behind its relevance in framing strategic decisions. The intention is to simplify its application, for compatibility and easy understanding.

4.4.1 Definition of Real Options

Real-options analysis applies financial-options theory to capital investments and is "real" because you are investing in operating capital and physical assets instead of financial assets and an "option" because you have the right, but not the obligation to invest.

A real option is the right but not the obligation to take an action (e.g. deferring, expanding, contracting, or abandoning) at a predetermined cost called the exercise price, for a predetermined period of time – the life of the option. See e.g. Copeland and Vladimir (2000). A real options approach to investment decisions incorporates value of managerial flexibility in strategic investment decisions.

Real options are not only a valuation methodology, but also a new way of looking at the dynamics of investment decisions. It integrates valuation and decisions making, aiding the practitioners, make strategic decisions while incorporating

uncertainties in strategic investment decisions. Kulatilaka and Amram, (1999) present it as a tool vital in developing a strategic vision for firms, an application that is possible in framing supplier-sourcing decisions. A purchasing example will be used to illustrate real options application in the purchasing context. With reference to financial[33] theory, a real option approach to investment decisions is an extension of financial theory to options on real assets and classified according to the type of flexibility that they offer to the firm. While financial options are detailed in the contract, real options are embedded in strategic investments, and must be identified and specified.

Since real options are classified according to the type of flexibility they offer to the firm, this means that they are tailored to specific investment decisions. The aim of discussing them in this thesis is to extend real option analysis to purchasing and sourcing decisions.

4.4.2 Financial Options

This section presents a brief background to financial options, a basis for understanding real options. The underlying[34] for a financial option is a security such as a share of common stock, a bond or interest rates, while the underlying for a real option is a tangible asset, for example a business unit or investment project. Both types of options are the right, but not the obligation, to take an action (Copeland and Vladimir, 2000).

If options are written on a firm's shares, the firm may not issue financial options but independent business agents will issue them. These agents have no influence over the actions of the company and no control over the company's share price. This is a major difference with real options in that the management controls the

---

33 See e.g. Kulatilaka and Amram, (1999), Copeland and Vladirmir, (2000), Trigeorgis, (1995) for further discussion.

34 The underlying – an instrument on which an option or futures contract is based.

underlying such as business investment projects, on which they are written. For example, a firm may have the right to give up an investment project if its present value is low.

Call options: A call option is the right to buy the underlying asset by paying the exercise price and at the time of exercise, the profit on the option is the difference between the value of the underlying asset and the exercise price. See e.g. Trigeorgis, (1995).

Put options: Put option is the opposite, the right to sell the underlying asset in exchange of the exercise price. Both options could be American or European[35.]

4.4.3 Examples of Real Options

Growth options: Growth options provide the firm with opportunities later, to undertake profitable follow – on investments, which normally have the potential to lead to new opportunities with higher profitability. See e.g. Burkley (1998). An example of more insight to growth options is given below.

An automotive company is planning an aggressive sale of cars through a network of independent dealers and is considering whether to enter the market in China. The initial investment in local manufacturing and sales organisation is big, but it may lead to opportunities to sell a big range of brands through an established dealer sales network. A traditional analysis using DCF cash flow methods such as NPV shows that costs exceed forecasted profits. A real options analysis shows that the entry investment should be made because it creates growth opportunities in the Chinese market, options to take on more production of cars if the initial investment was a success. From the example we realise that real options can be vital in shaping a firm's strategy if used together with DCF cash flow analysis.

---

35 European options are exercised at their expiration date while American options can be exercised at anytime during the option lifetime. See e.g (Hull 1998).

Sourcing investments in the auto industry are carried out globally and from the above example, there is a clear signal of the presence of growth opportunities in such an investment, an indication that sourcing decisions can be shaped in such a framework.

In this case example, investing in new opportunities is a pre-emptive, relatively inexpensive and painless way short term (the option premium) but gives the scope to increase involvement later on, if investment is successful (the exercise of the option). According to Kulatilaka and Amram, (1999), application of a real option approach must be tailored to the specific industry and market. Such insights from the real options way of thinking are relevant across industries and in many international investment decisions. The aim here is to extend real option use in making of supplier sourcing decisions where applicable.

Flexibility options: Flexibility options arise as a result of the management's ability to make contingent business decisions[36]. In other words, flexibility options make use of already existing investments and enable the holder to be exposed to other opportunities other rather than being static. We take further explanations through the following example:

An automotive company must build a new plant for the production of its latest car model. The forecast for the new product showed that sales are highly uncertain and spread across two continents. A traditional manufacturing analysis suggested that one plant would be cheaper to build and operate. A real options analysis showed a greater value in building two plants, one on each continent, creating an option to switch production depending on business environment at the two manufacturing locations. A traditional DCF analysis missed how investing in an option to switch creates value out of uncertain events.

From a purchasing point of view, an example is a car manufacturer who invests in two suppliers at different sources, to have the flexibility to switch between both

---

36 Decisions made because an event has happened and if the event changes, the decisions change.

suppliers, depending on who is favourable at a particular moment in time. In this case, flexibility gives the right without the obligation, to switch between the cheapest sources. In this example, application of a real option approach will additionally attach value to such a strategy given value from the DCF analysis.

Switching options: As an example, an automotive company can incur investment costs with two suppliers 1 and 2 to provide a component, with the aim of keeping a relationship with both suppliers. This makes switching between them easier in case of uncertainties. Examples of uncertainties could be in the form of prices, car demand and other. A real options approach will attach value to the switching option. Therefore, switching options[37] occur when a firm faced with a single source of uncertainty incurs different relationship specific costs with multiple agents.

Learning options: These are options where uncertainty can be resolved through a learning process. The processes can be broken down into stages, and a real options approach used to value the contingent decisions.

An example of a learning option is staging investments in phases thus creating the option to abandon, if the investment is unfavourable. During the starting phase, management gets information regarding the business environment and if unfavourable, investment can be abandoned. Each stage can be viewed as an option on the value of subsequent phases and valued as a compound option[38]. In the purchasing context, an example is a strategy of selecting suppliers from a new market. These suppliers are assigned a smaller percentage of required total volumes, with the aim of learning the market. In the case of the initial investment turning out well, further sourcing can be continued in that market.

---

37 See (e.g Shrikhande & Subramanian; 2002) for a detailed discussion

38 Compound options are options on options. See Copeland and Vladirmir, 2000) for further discussion.

4.4.4 Valuing Real Options

Real options can be valued, with the implication that corporate sourcing strategies can be quantified. Valuation does not disregard the fact that qualitative evaluation can be used to come up with approximate values given the practitioners past experience of different purchasing scenarios. Valuation of real options has taken advantage of the valuation framework developed initially for financial options by Fisher Black and Myron Scholes. Variables for financial options valuation have been extended as value drivers for real options valuation (options on investments).

The six key variables[39] that determine the value of an investment are:

■ The value of the underlying asset

With real options, this is the present value of the investment. If the value of the underlying investment goes up, so does the value of the option on this investment.

■ Investment cost

This is the amount of money paid to exercise the option or the amount of money received on selling the option. If the exercise price (investment cost) increases, the option value decreases for a call and increases for a put option.

■ Time to maturity

This is the lifetime or duration of an investment. E.g. purchasing investment in a supplier. As the time to expiration increases, so does the value of the option.

■ Risk free interest rate

This accounts for the time value of money and if the rate goes up, the value of the option goes up.

---

39 For further discussion of the variables, see e.g. Copeland and Vladirmir (2000); Kulatilaka and Amram, 1999; Trigeorgis ,1995)

- Volatility of the underlying asset

This is the risk of the underlying investment and the more risk, the higher the value.

The variables above allow the practitioner measure or qualitatively estimate strategic value. Much of the value of the real options approach comes from framing the investment strategy and then applying available valuation tools, e.g. the Black scholes valuation and binomial option pricing models.   From a purchasing point of view, real options exist in the form of a firms' sourcing strategic decisions. Decisions are made with the aim of creating value from suppliers to the firm. Before reaching sourcing decisions, purchasers try to understand the items to be sourced and an appropriate strategy. This leads to a further brief discussion of the purchasing portfolio approach presented by Kjalics (1983).

4.5   Kjalics' Portfolio Approach to Purchasing and Sourcing

So far the discussion has been focused on methods in support of purchasing decisions from a financial point of view. It is time to understand item categories and appropriate sourcing strategies. The aim is being able to spot real options embedded in sourcing situations. The automotive industry is characterised by sourcing of different products with different supply risks, complexity[40] and financial impact to the value chain. The implication is that components are classified, which affects both purchasing and sourcing strategies. Kraljic (1983) introduced the first, comprehensive portfolio approach for use in purchasing and supply management. By categorizing products in a 2×2 matrix, sensible guidelines were given for managing supplier relationships.

---

40 Complexity in the case of auto components will refer to component specificity.

This approach targets developing and implementing differentiated purchasing strategies by classifying products on the basis of two dimensions; profit impact and supply risk (low and high) and classifying items into four categories: Bottleneck, non-critical, leverage and strategic items.
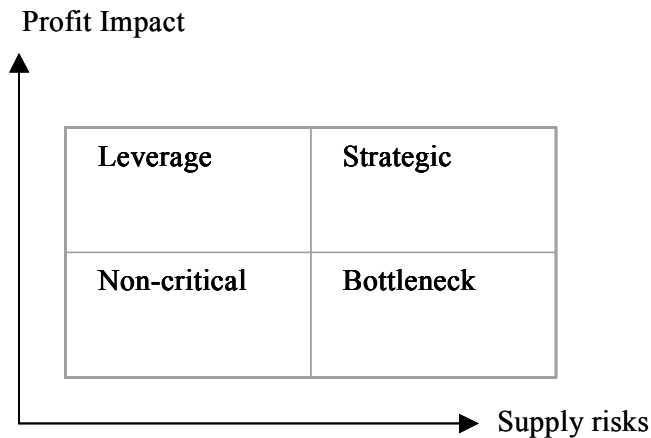
Profit Impact

Leverage	Strategic
Non-critical	Bottleneck

Supply risks

Figure 5, Product differentiation matrix showing profit impact and supply risks
Source: Kraljic portfolio approach (1983)

Non-critical: Non-critical items are less complex; require efficient processing, transactions mainly based on price, and usually very many alternatives and items with less financial impact.

Strategic: Strategic commodities are very complex and have high a financial impact. They require high investment costs.

Leverage: These commodities are less complex as well and require less investment costs, need for purchasing power exploitation, target pricing, require product substitution and high financial impact.

Bottleneck: Bottleneck items are very complex, that is very specific, require investments cost and involve a high supply risk.

4.5.1 Portfolio Approach from a Financial Point of View.

From a financial point of view, the approach has been interpreted in terms of financial impact, investment costs and complexity.
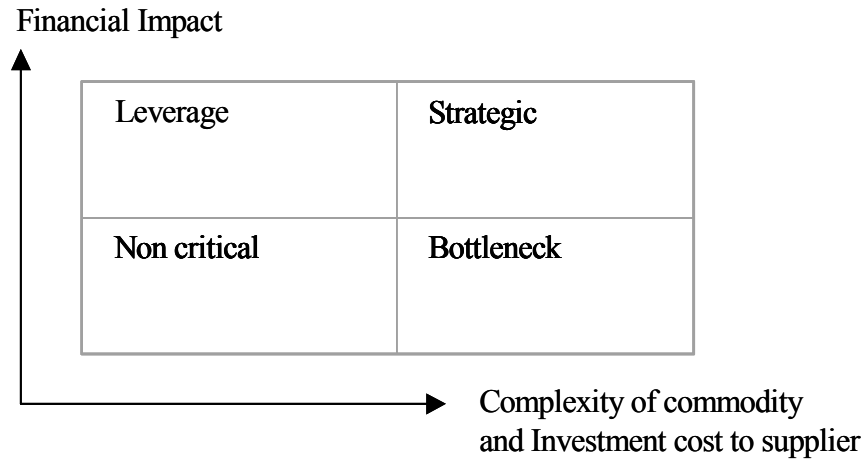
Financial Impact

Leverage	Strategic
Non critical	Bottleneck

Complexity of commodity
and Investment cost to supplier

Figure 6, Product matrix showing financial impact and investment cost.

Interpretation: The aim is to categorize items to be purchased and understanding both the financial impact and required investment at supplier sites. Earlier discussion of financial evaluation methods, recommended the NPV method for supplier evaluation. The NPV method uses investment costs and recommends supplier choice based on a financial value measure. The aim of the approach is to be a supportive guideline in the financial evaluation process of suppliers with the aim of achieving optimal purchasing decisions. From a real option point of view, strategic value is dependent on investment costs, which is one of the classification variables in the matrix. Given the portfolio approach[41], purchasing specialists can analyse sourcing alternatives and the respective strategic value they entail. This indicates the role of the matrix approach as a guideline to financial evaluation of supplier alternatives.

---

41 Application of the portfolio approach will be presented in the next chapters.

Switching options: Given the item categories, purchasers can determine which products have high flexibility value and whether it is valuable to switch between suppliers. Value from switching, from a real options stand point is dependant on investment costs and complexity, making the approach supportive to purchasers in a real options perspective.

Growth options: Lastly, based on the items to be sourced, purchasers can derive an understanding of potential suppliers and the necessary relationship to the firm. This enables purchasers spot suppliers with valuable future growth opportunities in the supply chain. Growth options are valuable and add to the competitiveness of a supplier or sourcing market with growth prospects.

Conclusions from Theoretical Support
This section has presented the relevant theoretical base necessary to achieve the purpose of this thesis. The conclusion was that the NPV method with a real options extension could be used to analyse supplier-sourcing alternatives to achieve optimal purchasing decisions. Its advantages have been discussed in the previous section and the method found to be more appropriate relative to other evaluation methods. Lastly, the purchasing portfolio approach was discussed as a way to understand items to be sourced from a financial viewpoint. The theoretical discussion gives a solid analytical basis for building a model for financial evaluation and analysis of supplier sourcing alternatives.

5   TOTAL VALUE MODEL

This section presents, suggests and discusses a Total Value Model (TVM) for evaluating and analysing supplier alternatives to take purchasing decisions from a financial point of view. This is in fulfilment of the purpose of this thesis and the following question, "what alternative models and methods can be used in evaluation and analysis of potential suppliers to support continuous purchasing process improvement?" earlier stated in the research focus.
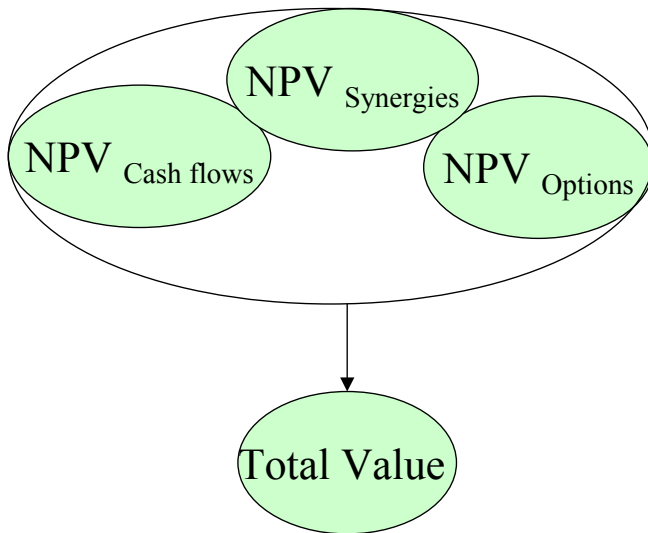
MODEL FRAMEWORK

Figure 7, TVM for evaluating and analysing potential supplier alternatives.

In reference to section 4, a theoretical support base was built, where financial investment methods were analysed from a purchasing point of view. Implications from theoretical analysis (section 4.3.4) showed that the NPV method was appropriate for analysing supplier alternatives from a financial standpoint. Given a justified basis for the NPV method, a TVM (figure 7) has been built around the purchasing process of VCC, based on NPV of supplier cash flows, synergies and

options. The aim of the TVM is to analyse and evaluate supplier business based on a total value measure that consolidates all commercial variables justify choice of suppliers. From this point of view, the TVM provides a framework for financial analysis of potential supplier alternatives aiding a purchasing specialist in making optimal purchasing decisions. The model analyses and evaluates suppliers on the basis of total value to the buying firm, in relation to the independent variables defined below:

$$TV = NPV_{Base\ case} + NPV_{Synergies} + NPV_{Options}$$

The respective dependant and independent variables are defined as below:

TV = Total value of business with potential supplier alternatives.

$NPV_{Base\ case}$ = Net present value base case (without business side effects [42])

$NPV_{Synergies}$ = Net present value synergies (e.g. common supplier VCC & FMC)

$NPV_{Options}$ = Net present value of options[43] (e.g. value growth opportunities for a chosen supplier alternative. Refer to section 4.4 for detailed examples)

5.1 Total Value

The Total value is the sum of the three independent variables in the model. They are $NPV_{Base\ case}$ resulting from supplier cash flows on quoted item prices, $NPV_{Synergies}$ resulting from purchasing economies of scale (item commonality and joint purchasing) and $NPV_{Options}$ arising from future opportunities (e.g. strategic value) that are embedded in sourcing alternatives. The model provides a framework to analyse supplier alternatives with the aim of reaching high value choices. The $NPV_{Base\ case}$ should always be considered but the $NPV_{Synergies}$ and $NPV_{Options}$ are

---

42 Business side effects in this case are other factors that add value such as synergies and future business opportunities.

43 This is strategic value as a result of choosing sourcing alternative.(e.g choice of alternative with future growth opportunities).

dependant on purchasing scenario at a moment in time e.g. Possible commonality and joint purchasing among car brands. Nevertheless, if item commonality among car models and joint purchasing operations exist, the TVM consolidates them to achieve a holistic quantified value measure of the supplier alternatives. Therefore, all value creating variables that exist at a given time should be included in the TVM.

5.2 Net Present Value Base Case

The NPV $_{\text{Base case}}$ is the NPV of the expected cash outflows to potential supplier alternatives under comparison. It is referred to as the base case because it is the starting point and a prerequisite. The base case is dependent on supplier price offers followed by item volumes to be sourced and cash outflows to each supplier alternative. In summary, it depends on the total commercial offer by a supplier. The method used to achieve the NPV base case is defined by the expression below:

$$\text{NPV}_{\text{Base case}} = -I + \sum_{t=0}^{T} \frac{C_t}{(1+r)^t}$$

Equation 3, Net Present Value[44] formula
Defined below:

NPV = Net present value base case
C_t = Forecasted[45] cash outflows to the suppliers in period t.

$I =$ Investment costs to the supplier.

$t =$ Planned time duration of the purchasing project.

$r =$ The cost of capital

The NPV $_{\text{Base case}}$ considers a supplier alternative with the **lowest NPV** as the most efficient alternative from a financial point of view.

5.3 Net Present Value Synergies

Synergy is the notion that the whole is greater than the sum of parts. Synergies are those activities that increase value of the combined business beyond the sum of the components and are a result of optimising economies of scale. In value terms, the expression below drives the understanding, and shows the value created as a result of synergies from a purchasing context.

$$NPV_{A+B} = NPV_A + NPV_B + NPV_{AB}$$

Equation 4, Net Present Value Synergies

Where A and B are two operations and the respective variables defined as follows[46]:

NPV_{A+B} = NPV of combined purchasing operations of both A and B.

NPV_A = Net present value purchasing operation A.

NPV_B = Net present value purchasing operation B.

NPV_{AB} = Incremental net present value due to combined operations of both A and B

---

46 Assuming A and B are two firms each with a separate purchasing operation.

From a purchasing point of view, synergies occur or are possible to achieve, when two discrete operations either share activities in the value chain or have asset transfer from one activity to the other. Given two combined purchasing operations A and B, the interaction term NPV $_{AB}$ is the value created as a result of combined purchasing operations of A and B.

The auto industry has had a trend towards increased mergers and acquisitions among auto firms. This has resulted into integration of purchasing operations among auto firms and optimisation of item commonality among car model components to drive towards high efficiency purchasing. This justifies the significance of the interaction term (NPV $_{AB}$) when synergies are optimised. Therefore, critical analysis should always be made in a purchasing scenario where there are possibilities of integrating purchasing operations and item commonality.

5.4   Net Present Value Options

The NPV $_{Options}$ is the value created as result of future strategic opportunities associated with a supplier alternative and discussed in section 4 as real options (which is only a finance terminology). Sourcing strategies that create strategic value (e.g. flexibility, switching, growth opportunities or options) can be quantified with the use of finance options pricing models to achieve a NPV $_{Options}$.

Nevertheless, purchasers can make qualitative assessments of the suppliers, their locations and items to be purchased in reference to the purchasing portfolio matrix discussed in section 4.5.1. Purchasers always have experience of the supplier market, up-to-date knowledge of auto-industrial sourcing trends and new supplier market information regarding the sourcing alternatives. They are always in a better position to make strategic value assessments. However, quantitative methods are valuable towards in terms of a quantified measure of a given strategy and in cases of high uncertainties in the supply chain.
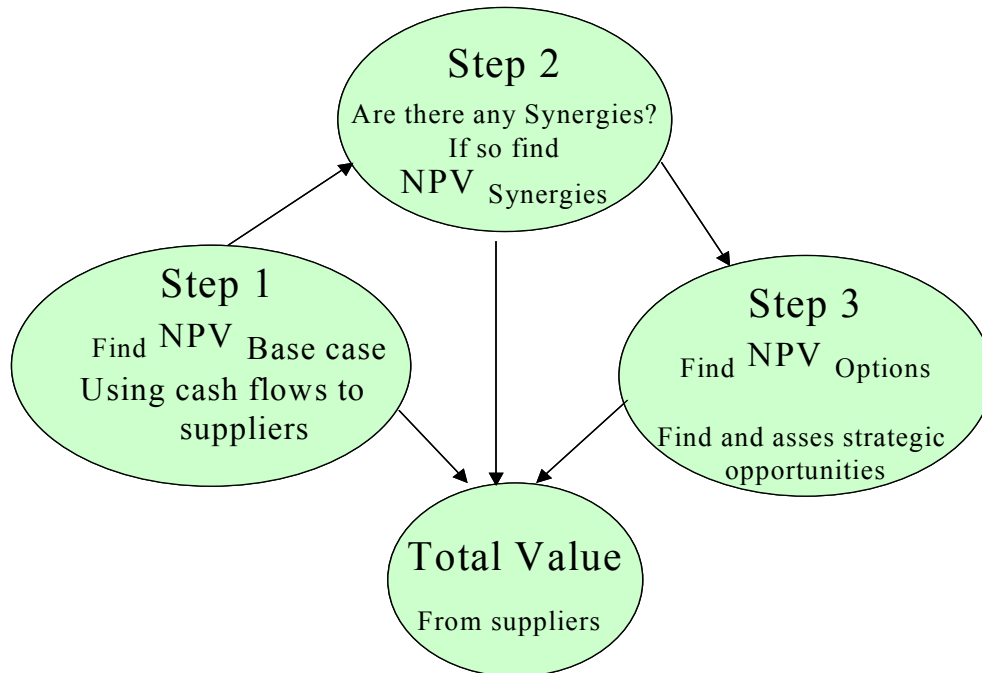
5.5 TVM steps

Figure 8, Total Value Model (TVM) steps

The model can be applied by performing the above steps discussed below.

▪ Step 1: Calculate NPV based on cash outflows to suppliers. Consolidate all supplier commercial data e.g. (price, productivity, leverage and other) to achieve a NPV for all potential supplier alternatives, which is a starting point and a prerequisite for using the TVM.

▪ Step 2: Identify all valuable purchasing synergies that can be optimised. E.g. item commonality and integrated purchasing. Derive the NPV $_{Synergies,}$ which should contribute to the total value. It should be noted that, Step 2 is dependent on existence of purchasing activities that can be shared in the value chain

▪ Step 3: Identify valuable strategic opportunities associated with sourcing alternatives. Measure and derive strategic value to achieve the NPV ₒₚₜᵢₒₙₛ.

It is vital to note that all steps discussed above, should contribute directly to the Total Value of the supplier alternatives under evaluation.

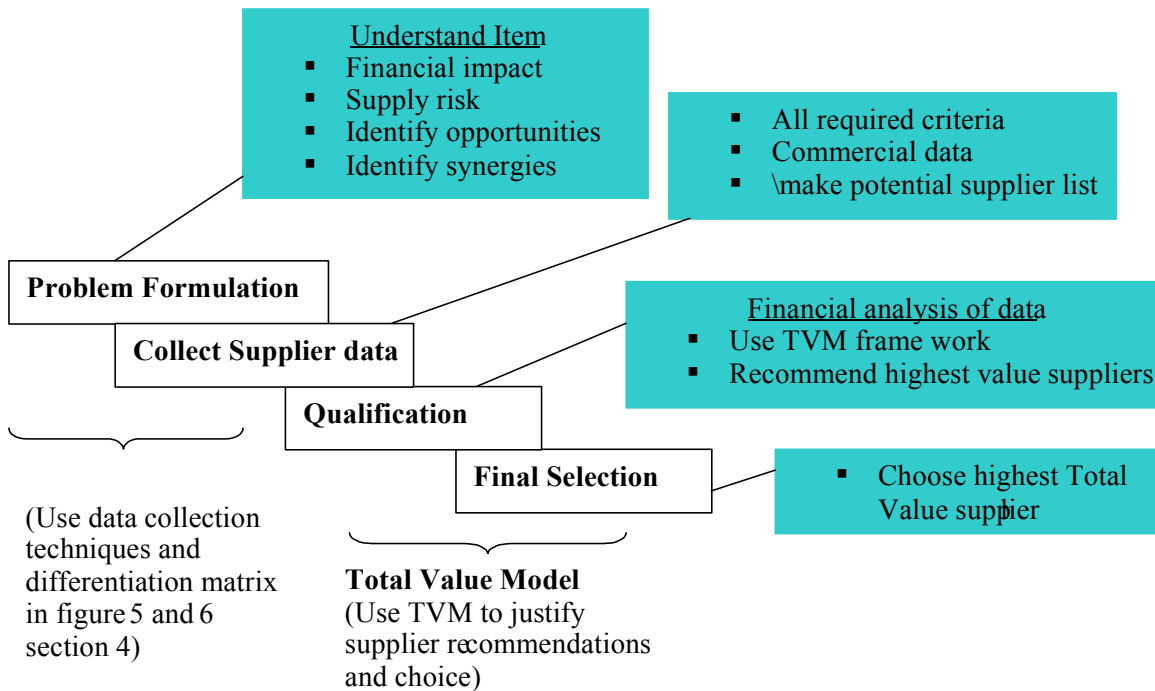## 5.6 TVM Application in the Supplier Selection Process

Figure 9, TVM application in the purchasing process.

Problem Formulation: Problem formulation is a vital when applying the TVM It requires the purchaser to understand the item to be purchased and therefore recommend the right potential supplier alternatives. Reference can be made to the matrices in figures 5 and 6 in section 4. The figures present the categories of items, complexity, financial impact, investment costs and supply risk. This

49

provides the purchaser with a background understanding of the supplier characteristics mentioned; an overview of would be potential suppliers and a perspective of the required level of competition and relationship among suppliers. At this stage, synergies and valuable strategic opportunities can be identified given a strong background understanding of the item. The problem formulation stage enables the purchaser define the purchasing task from a financial standpoint.

Collection of supplier data: After understanding the item, collection of supplier data can proceed where all the required commercial data is collected from the market for use in the next stages of the process. It's assumed that auto firms have sophiscated techniques to collect supplier commercial data.

Qualification of suppliers: At this stage, financial analysis of commercial data can be made using the TVM framework. All commercial data should be consolidated to achieve a single value measure. Therefore, depending on available data, all the steps in the TVM are performed and the results used to support recommendations to the final selection stage. Suppliers to be recommended should have the highest Total Value among available alternatives.

Final selection: At the final selection stage, TVM results from the recommendation stage can be used to support choices of suppliers. These should be suppliers with the highest Total value from a financial point of view.

5.7 TVM assumptions

▪ TVM evaluates suppliers from a financial point of view and does not take into consideration other critical factors for making purchasing decisions in the auto industry, e.g. quality, design, engineering and other supplier performance factors. The TVM can be used as a tool to support decisions from a financial standpoint. The assumption made is that decisions are made after contributions by purchasing teams from the functions of quality, design, engineering and other relevant.

▪ It assumes that the purchaser or the buying firm should choose the appropriate cost of capital for purchasing investments. The use of an appropriate discount rate is vital in adjusting investments for risks and time value for money (opportunity cost of capital). E.g. the Weighted Average Cost of Capital (WACC)

▪ The purchasing specialists should identify value creating variables e.g. synergies and strategic options among supplier alternatives to be used in the TVM.

5.8 TVM Summary and Strong Points

▪ Consolidates all supplier commercial data to one single metric (total value measure). Suppliers compete in different commercial aspects, which can be consolidated together to achieve the most valuable supplier choices. In other words, TVM evaluates suppliers based on Total cost during purchasing period to achieve a Total Value measure for comparison other than part price. In other words, TVM is forward looking.

▪ TVM puts into consideration the time value of money when the NPV base case is performed to analyse cash outflows to suppliers. Consideration of the time value for money allows VCC to use available cash resources as efficient as possible. In other words, TVM puts into consideration total cost development to the supplier alternatives to achieve efficient value based supplier choices.

▪ The model framework is supportive during negotiations to achieve efficient commercial results with suppliers. For example when negotiating for price reductions, a purchaser should consider the timing of price reductions with suppliers. The earlier the price reductions, the more valuable[47] to VCC if the time

---

47 A dollar saved today on an item, is worthy more than a dollar saved tommorrow.

value for money is considered. This applies to achieving both productivity targets and negotiations regarding leverage offer.

- The model puts into consideration value created as a result of strategic supplier sourcing decisions. Strategic decisions can be quantified by use of finance option pricing methods but a qualitative assessment can be used also.

- The TVM framework considers value resulting from synergies in purchasing operations. This is due to the fact that integrated purchasing activities and part commonality across models is common in today's auto industry. One supplier can be used for common items. This achieves cost savings e.g. tooling and search costs.

5.9   Purchasing Case to Illustrate the TVM.

To illustrate the practical use of the TVM framework, a purchasing case example has been worked out and involves finding the best value supplier choice out of six global supplier alternatives for item K. The steps followed are 1 NPV supplier cash flows, 2 NPV synergies and 3 NPV options as mentioned in figure 8. The intention is to use the TVM framework to evaluate an illustrative example using six potential alternatives to find the most valuable long run supplier where VCC is best in business. Commercial data concerning the supplier alternatives has been summarized in the tables below 2, 3 and 4 used to illustrate the TVM, where all **cash outflows are in Euros.**

Table 2

Supplier Name	Sup 1	Sup 2	Sup 3	Sup 4	Sup 5	Sup 6
1.Initial Investment costs						
a. Engneering cost						
b. Protype cost						
c. Specific Tooling cost						
d. Pre - production cost						
f. Total Initial Invest	490000	540000	560000	492000	780000	930000

Table 3

2.Piece Price Per Yr (landed cost)Incl.(Freight cost)						
a.Freight costs	0,32	1,15	0,90	1,60	1,35	1,30
b.Price Year 1	18,60	21,45	22,70	26,20	19,60	20,30
c.Price Year 2	18,50	21,45	22,60	26,20	19,50	20,00
d.Price Year 3	18,40	21,45	22,50	26,20	19,40	19,60
e.Price Year 4	18,30	21,45	22,30	26,20	19,30	19,30

Table 4

3. Cash out flows per year						
a.Year 1	837000	965250	1021500	1179000	882000	1154540
b.Year 2	2682500	3110250	3277000	3799000	2827500	2889850
c.Year 3	3220000	3753750	3937500	4585000	3395000	3430000
d.Year 4	3202500	3753750	3902500	4585000	3377500	3377500
e.Total cash flows	9942000	11583000	12138500	14148000	10482000	10851890

Annual Volumes	Units
Year 1	45000
Year 2	145000
Year 3	175000
Year 4	175000

Commercial data from the above tables was used to derive NPV $_{\text{Base case.}}$ It is the first step of the model and the intention is to work out the example in the simplest terms as possible.

Step one: NPV[48] Base case

Step one is worked out through the following sub-steps and reference will be made to the TVM equation for a clear flow of the illustrative example.

- **Sub-step one**: Identify all the related investment costs incurred by VCC before the suppliers start production. The aim is to include all the investment costs in one framework to achieve a single value for total supplier business with the six suppliers.

Table 2, 1(d) shows related investment costs to the six suppliers, although a detailed breakdown has not been presented. It should be noted that payment conditions should be put into consideration when making analysis.

- **Sub-Step two:** Calculate the expected cash outflows C_t to the six suppliers for the planned purchasing period, which is four years in this case example. Table 3, shows the negotiated price; table 4 shows the respective cash outflows to each supplier and lastly the respective volumes below the tables.

- **Sub-step three:** Discount the yearly cash outflows to the suppliers using VCC cost of capital to get present value of cash outflows to suppliers. An appropriate discount rate should be used and consultation can be made with management for the appropriate rate. A rate of 10% was used in this case example, which is VCC cost of capital.

- **Sub-Step four:** Sum up the investment costs and present value of cash outflows to get the NPV $_{Base\ case}$ using the NPV formular in equation 3. Accept supplier and recommend alternatives with the lowest NPVs, which are the most

54

valuable from a financial point of view, since we are dealing with cash outflows to suppliers.

NPV Results: Below is a summary of the NPVs of the six potential suppliers based on the above sub-steps and commercial data from tables 1,2 and 3.

Table 5, Showing NPVs in Euros for the Six Supplier Alternatives.

Suppliers	1	2	3	4	5	6
NPV in (000's) Euros	8,090	9,370	9,820	11,300	8,790	8,810

The NPVs above for each supplier alternative have been presented in a bar graph below for an overview and easy comparison of total business with the six suppliers.

Graph of NPVs in (000's) Euros Vs Suppliers
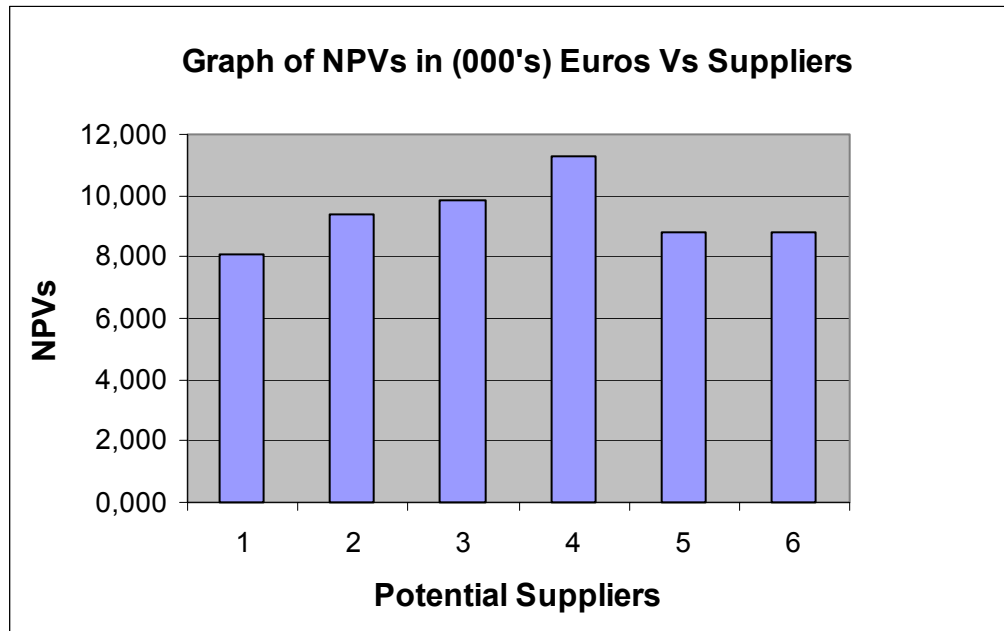
The above graph shows that supplier 1 has the lowest NPV and therefore the highest value alternative to VCC, wholly right from a financial point of view. Suppliers 5 and 6 are more competitive with lower NPVs in comparison to suppliers 2,3 and 4. Further evaluation will continue with suppliers 1, 5 and 6. The number has been reduced to 3, dropping 2, 3 and 4 to ease the selection process.

Lessons Learned from the NPV Base Case

- The method integrates both investment costs and annual cash outflows to one value measure. This is a consolidated NPV measure that gives a holistic view of total business with a supplier. In conclusion, method is forward looking.

- The method can be used to reduce the number of suppliers to fewer potential ones for further evaluation. In the case study example, supplier list is reduced to 1, 5 and 6 which are more competitive to VCC when the TVM is used for evaluation.

- The TVM framework puts into consideration the time value for money by handling differences in cash flow timing to suppliers. This includes timing[49] of productivities and leverage offered by suppliers. This implies that the sooner to achieve best offers, the more valuable to VCC.

---

[49] A dollar saved today from a supplier is worthy more than a dollar saved tomorrow.

Step Two: NPV Synergies

Step 2 involves deriving value from business side effects in purchasing operations. I assume there are purchasing economies of scale that can be optimised. When analysing business with suppliers, value created as a result of joint purchasing operations should be taken into consideration. This adds to the competitiveness of suppliers with valuable synergies.

▪ **Sub-step one:** In the case example, I assume VCC can purchase item K jointly with other firms of the FMC group and supplier 6 exists in the FMC supply base. The following advantages can be achieved if purchasing operations of component K are integrated.

▪ In the example, there are cost savings in terms of initial reduced investment costs. The investments costs can be split up between VCC and the FMC group, achieving a cost savings[50] of 44.1% with supplier 6.

▪ There are cost savings in terms of reduced piece price due to combined volume turnover. A renegotiation can be made and new prices as a function of combined volume obtained. Table 6, Shows expected synergy results (% price reductions and cash flow impact) with supplier 6.

---

50 Refer to the tables with commercial data.

Year	% price reductions due to combined volumes VCC + FMC	Cash flows without synergy effects consideration	Cash flows with synergy consideration
1	5	1,154,541	1,012,506
2	4	2,889,850	2,772,342
3	4	3,430,000	3,292,800
4	7	3,377,500	3,141,075
Total Cash flows		10,851,891	10218723
NPV no synergies		8,807,457	
NPV with synergies		8,091,934	

Observations from the table:

▪ Decreasing impact on cash outflows to supplier 6 due to reduced investment costs and a reduction in price as a function of volume.

To have a holistic overview of synergy effects with supplier 6, a NPV with synergy effects was calculated and compared to NPVs of suppliers 1 and 5.
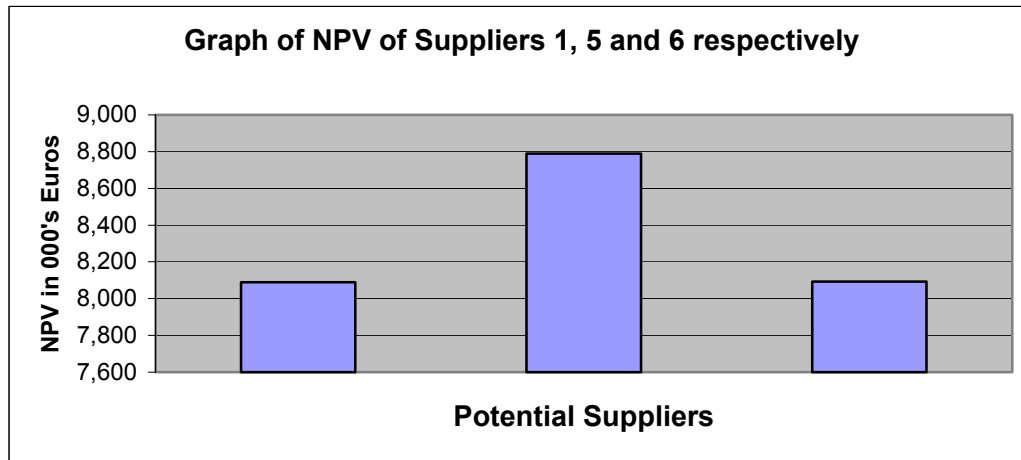
NPV supplier 6 (after adjustment for synergies) with that of suppliers 1 & 5.

Table 7, NPV of suppliers 1,5 and 6 after adjustment for synergies

Suppliers	1	5	6
NPV in (000's) Euros	8,090	8,790	8,092

The graph below shows the impact of synergies on the competitiveness of supplier 6, in relation to 1 and 5.

Graph 2, NPVs in 000's of Euros for suppliers 1, 5 and 6 respectively[51.]

Graph of NPV of Suppliers 1, 5 and 6 respectively

The graph above shows that supplier 6 is more competitive than 1 and 5 after adjustment for synergy effects. The most efficient choices are 1 and 6, which are more valuable to VCC from a financial point of view. Further evaluation will continue with 1 and 6.

Quantification of synergy effect in value terms: The expression below illustrates and shows value resulting from synergies when VCC and FMC use a common supplier for item K and is in reference to equation 4.

$$NPV\ ^{52}_{(VCC + FMC)} = NPV_{VCC} + NPV_{FMC} + NPV_{(VCC. FMC)}$$

---

51 The bar graph shows suppliers 1 for the first bar, supplier 5 for the second and 6 for the third bar.

52 The expression is in reference to equation 4 where $NPV_{A+B} = NPV_A + NPV_B + NPV_{AB}$ on page 4 3

The interaction term, NPV $_{(VCC. FMC)}$ stands for the incremental value when both VCC and FMC use a common supplier and defined by the expression below:

$$NPV_{(VCC. FMC)} = (NPV_{supplier\ 6,\ no\ synergies}) - (NPV_{supplier\ 6,\ with\ synergies})$$

The variables are defined below:

$NPV_{supplier\ 6,\ no\ synergies}$ = NPV for supplier 6 with consideration of synergies.

$NPV_{supplier\ 6,\ with\ synergies}$ = NPV for supplier 6 with no synergy consideration.

Table 8, Showing results in euros from the expression above:

NPV with synergies	8,807,457
NPV without synergies	8,091,934
NPV created as a result of VCC + FMC	715,523

NPV $_{(VCC\ .\ FMC\ group)}$ = 715,523 Euros, is the value created as a result of using a common supplier 6 common to both FMC and VCC.

Lessons learned from using supplier 6

▪ Value can be created by use of a common supplier and the result is valuable synergies in the supply chain. This has added to the competitiveness of supplier 6.

Step Three: NPV options

The (NPV Options[53]) is the third step of the model and comes from a real options perspective. The real options perspective from a purchasing point of view, considers that value from an investment (e.g. purchasing investment) comes not only from its cash outflow stream, but also from strategic sourcing decisions. Further analysis will proceed with a qualitative assessment of **NPV options** for suppliers 1 and 6 who are more competitive among the six alternatives.

Qualitative Valuation and Analysis: Using qualitative valuation and analysis will keep this exercise within reasonable comprehensible bounds and is supported by the following reasons:

▪ It is not always possible or desirable to eliminate subjective judgment but nevertheless qualitative valuation is very valuable.

▪ Strategic decisions regarding the most valuable alternative in a particular circumstance will often depend on purchasers' professional judgments about a range of criteria relating to financial issues, risk assessment, valuation of benefits, performance and other issues. The purchaser's experience regarding suppliers and sourcing markets is highly valuable.

Real Options Valuation for the NPV Options requires the following factors.

▪ Understand the item (component) to be sourced in relation to financial impact, complexity, supply risk, required relationship with supplier and investment costs. Reference will be made to figures 5 and 6.

---

53 Reference -Theoretical support section 4, for a real options discussion.

61

▪ Identify valuable real options embedded in the two supplier sourcing alternatives 1 and 6. Real options will be analysed in form of strategic value arising from using a supplier and sourcing from a particular market.

Item (Component) Positioning and Supplier Characteristics:

Financial Impact

| Leverage
•Component K's
Position in matrix | Strategic |
| Non critical | Bottleneck |

Complexity of commodity
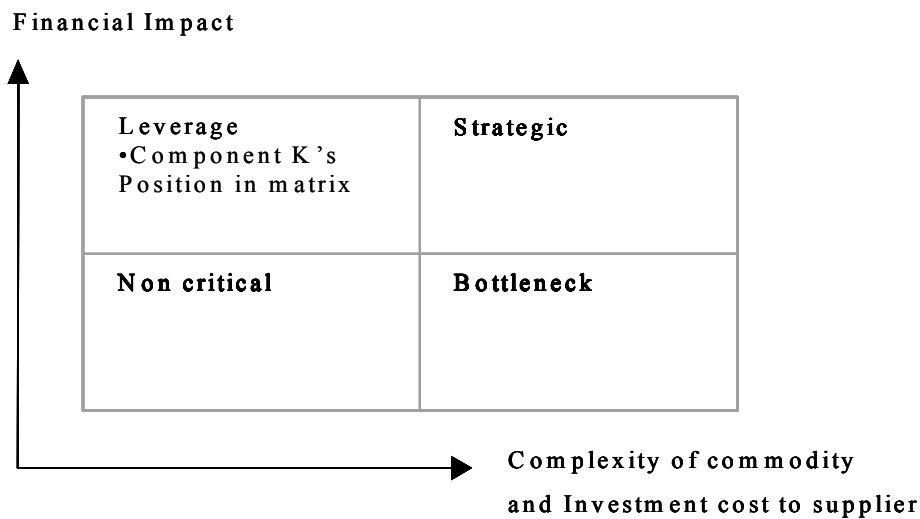and Investment cost to supplier

Figure 10, Item (component) and supplier characteristic

It can be observed from figure 10, that item K is positioned as a less complex item with many potential suppliers in the market and with high financial impact to VCC. It should be highly leveraged[54] and the following strategies put into consideration.

▪ There is need for price competitiveness between suppliers to reduce the financial impact.

---

[54] Big volumes should be sourced for VCC to get price reductions which is in line with synergy optimisation discussed in step 2.

▪ Component K should be highly leveraged in terms of increased item volumes to suppliers to achieve competitive price offers.

Given a critical understanding of the item, potential suppliers and financial impact, further analysis will proceed with evaluation of suppliers 1 and 6 from a real options point of view.

Identifying Real Options Embedded in the Two Supplier Alternatives.

Table 9, NPV in Euros and market locations of supplier 1 and 6.

Supplier	NPV	Market
1	8,091,134	High cost
6	8,091,934	Low cost

Growth option: From the table above showing NPVs of suppliers 1 and 6, supplier 1 has a lower NPV and therefore, more competitive compared to supplier 6 from a financial point of view. The efficient choice is supplier 1, but supplier 6 is strategically located in a low cost market, which is a competitive advantage over supplier 1. The Choice of supplier 6 has valuable (growth option) future growth opportunities. Current choice of supplier 6 facilitates future valuable sourcing opportunities in the low cost market. If supplier 6 is chosen today for item K and sourcing successful in the four-year period, a scale up of sourcing activities in that market can be made to optimise available opportunities.

Value of Growth Option (Opportunities)
The value of the growth option is a function of the following factors in relation to supplier 6. The value for the growth option is a function of investment costs, PV cash flows, time, Volatility and interest rate.

63

Investment Costs: Due to the fact that supplier 6 is a common supplier to both VCC and FMC there was a reduction in initial investment costs as earlier discussed in step 2. From a real option stand point, the lower the investment costs, the higher the value of a real option. This implies that the embedded (future growth opportunities) growth option is more valuable, given the fact that less investment costs would be paid get hold of this option.

Present value of cash Flow stream to supplier 6: The present value of expected cash out flows to supplier 6 have been decreasing throughout the analysis. This is due to the fact that supplier 6 is common to FMC and VCC and valuable synergies can be optimised. In reference to real options theory, reduction in expected cash outflows indicates an increase in the value of the growth option.

The lifetime of the sourcing project: The planned sourcing duration is four years. A longer time to expiration of a purchasing contract with supplier 6, will allow more information to learn more about market location of supplier 6. An option is more valuable the longer the time to expiration and thus the growth option becomes more valuable.

Volatility of present value of cash flows to supplier 6: Item K entails high leverage and price competitiveness among suppliers. According to figure 5, there are many suppliers for item K; there is need for competitive purchasing and business with suppliers should be highly leveraged. This is an indicator that the present value of cash flows to supplier 6 will be changing in given time periods. Price competitiveness among suppliers and highly leveraging item K overtime, allows for volatility cash outflows. The volatility of the present value of cash outflows reflects an increase in value of the growth option.

Final supplier choice from a financial point of view

Table 10, Total Value for suppliers 1 and 6

Supplier	NPV	Market	Total value
1	8,091,134	High cost	8,091,134
6	8,091,934	Low cost	8,091,934 + VGP

VGP is short for value growth opportunities (Growth option)

The TVM results from the table above show that supplier 1 has a lower NPV compared to supplier 6 and is therefore, the most valuable alternative. The presence of a strategic valuable growth option makes supplier 6 more competitive and most valuable choice from a financial point of view.

Final supplier choice:
The final supplier choice based on the TVM is supplier 6. The analysis has been based on evaluation of the total value from all the supplier alternatives as a function of NPV cash flows, synergies and real options. Total value for supplier 6 is presented below:

Total value = 8,091,934 + Value growth option

This is the TVM final supplier choice result. The result can be used to justify choice of supplier 6 and a basis for decision-making from a financial standpoint.

6 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this thesis was to investigate methods used by purchasers at VCC for financial analysis and evaluation of supplier alternatives. Based on the findings, the second purpose was to suggest an alternative model for financial analysis and evaluation of suppliers, contributing towards efficient purchasing decisions from a financial point of view. To achieve this purpose and a justified basis, empirical findings indicated that purchasers use several methods for financial analysis and evaluation of supplier alternatives.

 A financial, purchasing and supply theoretical base was built, integrated and used as a basis to analyse different methods regarding financial analysis of investments from a purchasing point of view. A discussion and analysis of the merits and shortcomings when used to analyse suppliers, led to the choice of the NPV method as suitable for comparison of supplier alternatives. This gave reasonable grounds to troubleshoot and the result was building a Total Value Model (TVM) around the purchasing process, based on NPV analysis of supplier alternatives. The TVM framework comprises NPV cash flows to suppliers, NPV synergies and NPV options.

NPV cash flows to suppliers, evaluates alternatives based on financial analysis of total commercial offers by suppliers, other than lowest price only. It consolidates all the commercial factors inclusive of initial investment costs, landed cost - price, productivity, leverage, payment conditions and other regarding a supplier to one value measure that can be used to compare alternatives to achieve high value suppliers. Lastly, the use of NPV cash flows puts into consideration the time value for money, which is a vital factor to achieve competitive purchasing business with suppliers. Given the time value for money, supplier alternatives compete differently in regard to timing of price reductions and leverage offers, thus the NPV background can be a valuable tool during negotiations with suppliers.

Secondly, the TVM framework includes NPV synergies with the aim of consolidating value as a result of scale economies between VCC and FMC purchasing operations. Value is created as a result of joint purchasing operations in the supply chain and should be put into consideration to arrive at a total value measure.

The TVM extends further to consolidate NPV options, value for strategic decisions when choosing between sourcing alternatives. Purchasing like other investments has real options embedded in strategic decisions. Through a purchasing case example, the growth option was identified and qualitatively analysed, despite the fact that quantitative analysis still remains a vital tool if the practitioner, most especially in cases of high business uncertainty, can apply it. TVM shows that value created as a result of strategic decisions can be quantified in value terms and should not be let out when deciding on the best value alternatives. Lastly, the TVM provides a framework that consolidates value-creating variables to a total value measure. The results can then be used to make efficient purchasing decisions, based on choice of high value suppliers from a financial perspective. The model is simple to use and compatible to purchasing practitioners.

Recommendations

▪ There is an opportunity to strengthen the current methods used for financial analysis and evaluation of suppliers within purchasing teams. TVM can be utilised as a standard framework to analyse and evaluate business with suppliers from a financial perspective, making purchasing decisions as efficient as possible. Nevertheless, purchasing decisions are made in line with other vital factors such as quality, design, engineering and other. The use of the TVM framework would be vital together with contributions from those functions.

▪ There is a need to highlight the time value of money, as it is very vital to allocate resources to efficient investments. Further, the TVM is forward looking and its background to purchasing specialists is vital for purchasing negotiations with suppliers to achieve valuable commercial results.

▪ TVM works with more commercial data to achieve best analytical results. Thus VCC should encourage working with more data among purchasing specialists to achieve efficient purchasing results.

Bibliography

Adrian Buckley (1998), A Real Options Approach. International Investment, Value Creation and Appraisal. Copenhagen: Copenhagen Business School Press.

Boer, L de Buter, J.I.H. Telgen, J., (1994). Purchasing as a Multi-Disciplinary Science. In: Biemans, W.G., Ghauri, P.N., (Eds.), Meeting the Challenges of New Frontiers. Proceedings of the 10th Annual IMP Conference, September 1994, Groningen, The Netherlands.

Boer, L. de. (1996), On a Renewed Acquaintance: Purchasing Meets Operations Research. In: Weele, A.J. van (Ed.), Heading for New Frontiers in Purchasing and Supply Management. Proceedings of the 5th annual IPSERA Conference, April 1996 Eindhoven, The Netherlands.

Boer, L.de., Wegen, and L.L.M. van der, (1996). A Outranking Approach to Supplier Selection, Working paper University of Twente UT-T & M.OMST.WP.96.06, Enschede.

Bragg, Steven M, (1998),Outsourcing: A Guide to; Selecting the Correct Business Unit, Negotiating the Contract, Mantaining Control of the Process. New York; Wiley.

Brigham Eugene (1995) ,Fundamentals of Financial Management. 7 ed. Drydenpress cop 1995.

Carter, Monczka, Slaight , T.H., Swan, and A.J., (1998), The future of purchasing and supply: a five- and ten year forecast. CAPS Research Report

Chris .W and Tim .G (2000),Using Real Options in Strategic Decision Making. Spring 2000, London school of economics.

Copeland and Vladimir (2000), Real Options, A Practitioners' Guide. London: Texere, cop. 2001

Copeland and Howe (2002), Real options and strategic decisions, Strategic finance – April 2002.

Copeland and Keenam (1998),How much is flexibilty worthy. The Mckinsey quarterly, spring 1998.

Cooper, Donald R, (1998), Business Research Methods. McGraw –Hill, cop 1998

De Boer, L., 1998. Operations research in support of purchasing. Design of a toolbox for supplier selection. Ph.D. Thesis, University of Twente, Enschede, The Netherlands.

De Looff, L., (1997), Information Systems Outsourcing Decision Making: a Managerial Approach. IDEA Group Publishing, Hershey, PA

Dyer, J., Cho, D., Chu, W, (1998), Strategic Supplier Segmentation: the next "best practice" in supply chain management. California Management Review 40 (2), 57-78.

Dyer, J.H., Cho, D.S., Chu, W., (1998), Strategic Supplier Segmentation. California Management Review 40 (1), 57-77.

Ellram, L.M. (1995), Total cost of ownership: An Analysis Approach for Purchasing. International Journal of Physical Distribution and Logistics Management 25 (8), 4-23.

71

Ellram, L.M., (1990) The Supplier Selection Decision in Strategic Partnerships. Journal of Purchasing and Materials Management 26 (4), 8-14)

Graham and Harvey (2001), The Theory and Practice of Corporate Finance: Evidence from the Field, Journal of Financial Economics, Vol. 60, and pp. 187-243.

Haka, Susan , Lawrence and George E. Pinches (1985), Sophisticated Capital Budgeting Selection Techniques and Firm Performance, The Accounting Review, Vol. LX, No. 4, pp. 651-669.

Harvey, J., (1998). Service Quality: a tutorial. Journal of Operations Management 16 , 583-597.

Hinkel et al C.L., Robinson, P.J. and Green, P.E., 1969. Vendor Evaluation using Cluster Analysis. Journal of purchasing 5 3, pp. 49–58.

Holt, G.D., 1998. Which contractor selection methodology?. International journal of project management 16 3,pp 153-164 cluster analysis

Klammer, Thomas (1972), "Empirical Evidence of the Adoption of Sophisticated Capital Budgeting Techniques", Journal of Business, July, pp. 387-397.

Kralijic, P., (1983), "Purchasing must become supply management". Harvard Business Review 61 (5), 109-117.

Kulatilaka and Amram (1999), Managing Strategic Investment in Uncertain World. Harvard Business School Press; London: McGraw-Hill, 1999

Liu J, Ding, F.Y. and Lall, V., 2000. "Using Data Envelopment Analysis to compare suppliers for supplier selection and performance improvement". Supply chain management: An international journal 5 3, pp. 143–150

Michael, Q (1998), Industrial procurement: "Factors affecting sourcing decisions". European journal of purchasing and supply management. 4 (1998) 199- 205.

Monczka, R.M., and Trecha, S.J., (1988). "Cost-based supplier performance evaluation". International Journal of Purchasing and Materials Management 24 (1), 2-7.

Monczka, R.M., Giunipero, L.C., Reck, R.F., (1981). "Perceived importance of supplier information". Journal of Purchasing and Materials Management 17 (1), 21-29.

Narasimhan, R., (1983). "An analytical approach to supplier selection". Journal of Purchasing and Materials Management 19 (1), 27-32.

Nembhard .B and Aktan .M (2001), "A real options design for product out sourcing" , Proceedings of the winter simulation confrence, 2001.

Oxenenfeldt (1979), Cost Benefit Analysis for Executive Decision Making:The danger of plain common sense, Amacon Newyork.

Papagapiou A., Mingers, J. and Thanassoulis, E., (1986). "Would you buy a used car with DEA"?. OR insight 10 1, pp. 13–19.
Pike, Richard and Bill Neale (1999), Corporate Finance and Investment. Barcelona: Prentice Hall Europe. Third Edition.

Pinsoneault A. A. and Kraemer, K.L., 1989. "The effects on electronic meetings on group processes and outcomes". an assessment of the empirical research. European journal of operational research 46, pp. 143-161

Ross, Stephen, Randolph W. Westerfield and Jeffrey F. Jaffe (1999), Corporate Finance,Boston: McGraw-Hill International

Saunders Mark N.K (2000), Research Methods for Business Students. Financial times / pretence hall , cop 2000.

Steven Phelan (1997), "Exposing the illusion of confindence in financial analysis". Management decision science, 35/2 (1997) 163-168.

S.T. and Skitmore, R.M., (1995). CP-DSS: "Decision support system for contractor prequalification". Civil Engneering systems

Timmerman, E, (1986). "An approach to vendor performance evaluation". Journal of Purchasing and Materials Management 22 (4). 2-8.

Timmermans E., (1986). "An approach to vendor performance evaluation". Journal of purchasing and supply management 1, pp. 27–32.

Trigeorgis Lenos (1999), Real Options and Business Strategy, Applications to Decision Making

Venderembse M.A. and Tracey, M., (1999). "The impact of supplier selection criteria and supplier involvement on manufacturing performance".The journal of supply chain management: Global review of purchasing and supply 35 3, pp. 33–39.

Wachowicz and Van Horne (1995) Fundamentals of Financial Management. Prentice – hall London.

Weber C.A., (1991). "A decision support system using multicriteria techniques for vendor selection". University Microfilms International, Ann Arbor, MI.

Weber, C.A, Current, J.R. and Desai, A., (1998). "Non-cooperative negotiation strategies for vendor selection". European Journal of Operational Research 108 (1), 208-223.

Weber, C.A. and Ellram, L.M., (1993). "Supplier selection using multiobjective programming". A decision support systems approach. International Journal of Physical Distribution and Logistics Management 23 (2), 3-14.

Weber, C.A.and Current, J.R., (1993). "A multiobjective approach to vendor selection". European Journal of Operational Research 68 (2), 173-184.

Zenz (1981), Purchasing and the Management of Material, Wiley, New York.

Electronic sources
www.volvocars.com and the Intranet.

Appendix 1 : Interview guide questions

Item: department:
Supplier identification process

1. Responsibilities as a purchaser ?Complexity and financial impact of item?

2. Main sourcing markets? Global ?

3. How are suppliers identified ? New sourcing opportunites?

4. How many supplier alternatives are identified for a particular assignment?
 Comments?

5. How many suppliers are needed for an efficient comparison?
Number and why?
Comments if any?

 6. How long does the process take from identification to final supplier choice for the item you purchase?

7. What is the duration of the purchasing contracts for item and factors behind a given duration? Supplier relationship?

Commercial related issues

8. How complex is the item? Its financial impact to VCC?

9. What are the basic commercial factors leading to recommending of a supplier out of available alternatives?

10. How do you arrive to a reasonable price for an item and what factors are put under consideration? Comments about the target price?

11. What is the basis for decisions if no target price is set?

12. How does the target price affect your decisions?

13. Does the item involve initial investment costs to the supplier?. If so, what is the overall breakdown of initial investment costs to a supplier?

15. What are the payment conditions of these costs?

16. What methods do you use to analyse initial investment costs to suppliers after decisions?

17.What methods are used to evaluate and analyse supplier alternatives, given all the commercial factors from the different suppliers.

18.Are there any standardised methods for evaluating and analysing business with suppliers?

19. Do methods differ between purchasers?

20. How do you see purchasing as adding value to the company as a whole?

21.Are the decisions made based on total value of business from supplier or price?

22. Comment on commercial negotiations. When are they carried out? what methods are used to achieve best results.

23.What comments can be made regarding efficiency of purchasing decisions. (Efficiency in methods used and purchasing processes)
(In regard to commercial factors?)

24.Are there any challenges regarding purchasing decisions making? (From a commercial point of view?

Appendix 2 : Previous research works in the supplier selection area

Categorical methods: Categorical methods are basically qualitative models. Based on historical data and the purchasers experience current or familiar suppliers are evaluated on a set of criteria. The evaluations actually consist of categorizing the supplier's performance on a criterion as either `positive', `neutral' or `negative'. After a supplier has been rated on all criteria, the buyer gives an overall rating, again through ticking one of the three options. In this way, suppliers are sorted into three categories. For further discussion see Zenz, (1981) and Timmermans, (1986).

Data envelopment analysis (DEA): DEA is built around the concept of the `efficiency' of a decision alternative. The alternatives are evaluated on benefit criteria (output) and cost criteria (input). For each supplier, the DEA method finds the most favorable set of weights, i.e. the set of weights that maximizes the supplier's efficiency rating without making its own or any other supplier's rating greater than one. In this way the DEA method aids the buyer in classifying the suppliers (or their initial bids) into two categories: the efficient suppliers and the inefficient suppliers. Weber has primarily discussed the application of DEA in supplier selection in several publications; see Weber and Ellram, (1992); Weber and Desai, (1996) and Weber et al., (1998). Apart from just categorizing suppliers, Weber shows how DEA can be used as a tool for negotiating with inefficient suppliers.

Cluster analysis (CA): CA is a basic method from statistics, which uses a classification algorithm to group a number of items, which are described by a set of numerical attribute scores into a number of clusters such that the differences between items within a cluster are minimal and the differences between items from different clusters are maximal. CA can also be applied to a group of suppliers that are described by scores on some criteria. The result is a

classification of suppliers in clusters of comparable suppliers. For further discussion See e.g. Hinkle et al. (1969).

Case-based-reasoning (CBR) systems: CBR systems fall in the category of the so-called artificial intelligence (AI) approach. Basically, a CBR-system is a software-driven database, which provides a decision-maker with useful information and experiences from similar, previous decision situations. CBR is still very new and only few systems have been developed for purchasing decision-making. Ng et al. (1995), e.g developed a CBR-system for the pre-qualification of suppliers.

Decision models for the final choice - phase
Furthermore, a short discussion of models from previous researchers used in the final choice phase and a concluding summary of how they address the issue suppliers selection from a financial point of view.

Linear weighting models: In linear weighting models , weights are given to the criteria, the biggest weight indicating the highest importance. Ratings on the criteria are multiplied by their weights and summed in order to obtain a single figure for each supplier. The supplier with the highest overall rating can then be selected.

Total cost of ownership (TCO) models: TCO-based models attempt to include all quantifiable costs in the supplier choice that are incurred throughout the purchased item's life cycle. Following from Ellram (1994) a distinction can be made between pre-transaction, transaction and post-transaction costs. TCO-based models for supplier choice basically consists of summarization and quantification of all or several costs associated with the choice of vendors and subsequently adjusting or penalizing the unit price quoted by the supplier with this figure in some way. For organizations with computerized cost accounting systems. Timmermans (1986) proposes the cost-ratio method. This method collects all costs

related to quality, delivery and service and expresses them as a benefit or penalty percentage on unit price. Monczka and Trecha (1988) and Smytka and Clemens (1993) combine a total cost approach with rating systems for criteria such as service and delivery performance for which it is more difficult to obtain the cost figures.

Mathematical models: Given an appropriate decision setting, MP allows the decision-maker to formulate the decision problem in terms of a mathematical objective function that subsequently needs to be maximised (e.g. maximize profit) or minimized (e.g. minimize costs) by varying the values of the variables in the objective function (e.g. the amount ordered with supplier X).

Statistical models: Statistical models deal with the stochastic uncertainty related to the vendor choice. Although stochastic uncertainty is present in most types of purchasing situations, e.g. by not knowing exactly how the internal demand for the items or services purchased will develop, only very few supplier choice models really handle this problem. These published statistical models have been criticized for only accommodating for uncertainty with regard to one criterion at a time.

Artificial intelligence (AI)-based models: AI-based models are based on computer-aided systems that in one way or another can be `trained' by a purchasing expert or historic data. Subsequently, non-experts who face similar but new decision situations can consult the system. Examples of methods based on artificial intelligence (AI) technology that have been applied to supplier choice include neural networks and expert systems. Although only a few examples of AI methods applied to the supplier evaluation problem can be found in the literature to date it is important to investigate these methods for their potentialities.