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A METHODOLOGY FOR COST AND RISK REDUCTION IN
PURCHASING AND SUPPLY MANAGEMENT

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Abstract

Automotive manufacturers in the UK and other industrialised nations face competitive pressures from rivals with lower underlying cost bases. Reducing costs and risks is of increasing importance, and purchasing and supply management can make a substantial contribution to this. This work delivers a validated methodology for meeting the challenges that purchasers are most often facing in automotive manufacturing facilities operating in industrialised markets.

The aim of this research is to develop *a novel methodology for identifying and implementing cost reduction activities for the purchasing function of automotive companies. Specifically the methodology presented here defines activities which implement continuous improvement in the purchasing process including; costing, sourcing, stocking, and social responsibility assessment.*

A literature review and interviews with practitioners in industry were used to explore how strategic purchasing is implemented in the field and identify the key issues facing practitioners. Using these findings, a skeleton methodology for strategic purchasing and supply management was developed. This skeleton methodology brought together; (i) the capturing of social responsibility competency in the supply base and a formal means of measuring and reporting supplier compliance, (ii) techniques for the identification of price reduction candidates and the comparison of dissimilar supplier bids, and (iii) techniques for the identification of stock reduction candidates and the use of supplier knowledge in stock reduction. A study was conducted to address each of these areas individually the results of which were validated through real-world findings from the purchasing environment of the industrial collaborator. The skeleton methodology was validated using a series of questionnaires with experts from industry and academia.

The corporate social responsibility component of the methodology identified suppliers which posed a potential resourcing risk to the industrial collaborator, the acquisition cost reduction component found 8% of cost savings, and the inventory holding reduction component found 7% savings. The methodology has been shown to provide an operational link between a manufacturer's strategic need to reduce costs and risks and the capabilities of purchasing functions and professionals. The implications of this work are that purchasing can now be used as a means to achieve a competitive advantage.

Acknowledgements

The research presented here has only been possible due the help and support I have received from those closest to me and those closely associated with the work.

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I would also like to say thank you to my industrial supervisor Christine. She integrated me into her team from the very beginning and made the work possible.

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Journals

TIWARI, A., YOUNIS, K., TURNER, C., SACKETT, P. and BAUTISTA, M.C., 2010. Capturing and evaluating process information for high-performance complex manufacturing operations. *Journal of Manufacturing Technology Management*, 21(5), pp. 585-603.

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Chapter 1

Introduction

1.1 Introduction

This chapter introduces the programme of research undertaken during 4 years of the Engineering Doctorate. This chapter consists of five main sections. Firstly, an overview of the research topic and background information is provided in Section 1.3. The research aim and objectives are outlined in Section 1.4. The design of the research programme to realise those objectives is given in Section 1.5. A summary of the contribution that this research has made to the body of knowledge is provided in Section 1.6. And lastly, a high-level view of the thesis structure is outlined in Section 1.7.

1.2 Chapter Structure

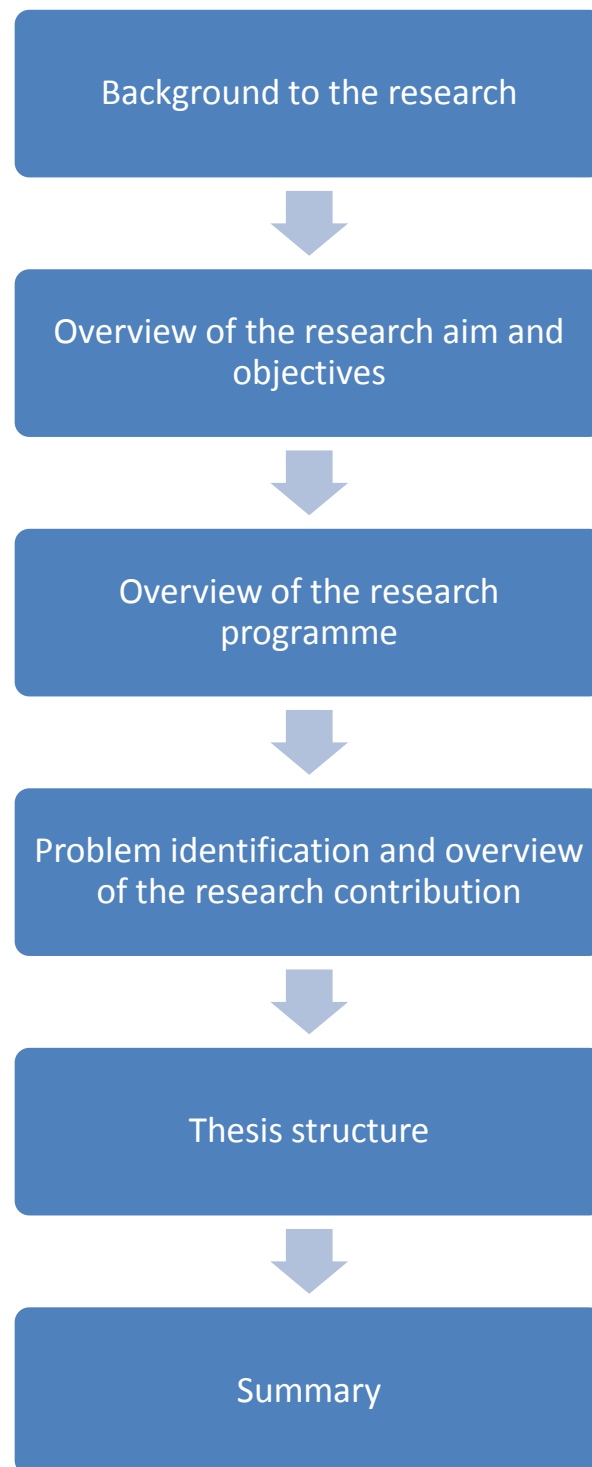


Figure 1-1. Chapter structure

1.3 Background to the research

The International Financial Crisis and subsequent economic recession has forced manufacturers (particularly automotive manufacturers) to take urgent action to reduce their cost base. Although this need existed before the crisis, it was substantially exacerbated by it. The long-term trend of manufacturing has been to move production facilities to low-cost economies such as Eastern Europe and the BRIC nations (Brazil, Russia, India, and China). Manufacturers such as the sponsor company, who have invested significantly in facilities in the UK are therefore keen to find new ways of creating value in their business processes while reducing costs. Supply chain management is one area that has received much attention from the research community, but purchasing in its own right has often been neglected or relegated to that of a minor contributor. That position is now changing as both practitioners and the research community have come to realise the strategic importance that purchasing plays in the success or failure of a manufacturing operation.

The automotive industry makes a substantial contribution to the overall competitiveness of the UK economy. The industry supports technological advancements that feed into other areas of research and development and are ultimately exploited to the benefit of other industries. The sector represents around one eighth of UK manufacturing output and supports approximately half-million jobs. Recent years have seen global growth of 2.5% (BERR, 2009), although much of that is accounted for by the BRIC nations. Strategic purchasing is one area in which UK manufacturers can take the lead over their counterparts in other global regions. As will be demonstrated in this thesis, strategic purchasing relies less on capital investments, and more on methodological purpose and rigour.

To summarise, as a quickly developing field of study purchasing research remains important both in its own right and as part of wider supply chain investigations. Despite a great deal of research conducted across the various themes of the purchasing process, there remains dearth of research which brings this together into a holistic methodology for strategic purchasing. This gap was identified through an intensive literature survey and will be addressed as this thesis unfolds.

1.4 Overview of the research aim and objectives

The purpose of this section is to introduce the reader to the research aim and associated objectives. A more comprehensive treatment of these can be found in Chapter 4.

The aim of this research is to:

“Develop a novel methodology for identifying and implementing cost reduction activities for the purchasing function of automotive companies. These activities will implement continuous improvement in the purchasing process, including costing, sourcing, stocking, and social responsibility assessment.”

To realise this aim, the following objectives have been identified and executed:

1. Explore how strategic purchasing is implemented in the field and identify the key issues facing practitioners.
2. Provide a representation technique for the identification of price reduction candidates and the comparison of dissimilar supplier bids.
3. Capture the social responsibility competency of the supply base and provide a formal means of measuring and reporting supplier compliance.
4. Provide a representation technique for the identification of stock reduction candidates and investigate the use of supplier knowledge in stock reduction.
5. Design a skeleton methodology for strategic purchasing that assimilates the results of Objectives 2 to 4.
6. Validate the research results within the purchasing environment of the industrial collaborator (Objectives 2-4) and through structured interviews (Objective 5).

1.5 Overview of the research programme

The purpose of this section is to summarise the main phases of research and field work that were carried out in accordance with the objectives previously described. Chapter 4 gives a fuller treatment of these stages in the research process.

The first stage of the research programme was designed to meet the requirements of Objective 1 and is described in full in Chapters 2 and 3. The investigation into management issues has provided the author with an understanding of the business context into which the outputs from the research site. The literature review has provided a platform of knowledge from which future studies have been designed. The literature review has identified the key components of purchasing practice and how it can be improved in order to reduce costs particularly those pertinent to the automotive sector. It provides a basis for the development of the skeleton methodology.

Introduction | Problem identification and overview of the research contribution

The development of the skeleton methodology, as described in Chapter 5, was undertaken to support Objective 5. The skeleton methodology was developed based on the findings of the literature and early investigations in the field. The skeleton methodology brings together the key purchasing themes into a coherent Purchasing Cost and Risk Reduction Methodology (PCRRM).

In addition three field studies are conducted in coordination with the sponsor company, and were designed to support Objectives 2-4. The three studies constitute the body of the PCRRM. These case studies investigated how purchasing can be improved across; supplier selection through based on pricing, supplier selection using corporate social responsibility, and the use of suppliers in inventory reduction.

- The first of these studies is described in Chapter 6 and investigates corporate social responsibility in the supply base and how this can be measured to inform practitioners of risks.
- The second is described in Chapter 7 and develops a technique for identifying price reduction candidates from the supply base by comparing dissimilar bids.
- The final study is described in Chapter 8 and investigates inventory reduction and how knowledge present in the supply base can be utilised to help automotive manufacturers reduce the inventory holding of machine spares and general consumables.

The final phase of the programme is the validation of the PCRRM. The results and findings of the case studies designed to meet Objectives 2 to 4 are used here to populate the skeleton methodology. The validation and verification of the findings is carried out through the use of a panel of experts.

1.6 Problem identification and overview of the research contribution

The purpose of this section is to introduce the reader to the contribution that the research presented in this thesis has made to the body of knowledge. A fuller discussion and explanation of this is provided in Discussion and Conclusions (Chapter 10).

The main contribution to the body of knowledge made by this research is the development of the Purchasing Cost and Risk Reduction Methodology (PCRRM). The PCRRM is a practical tool for strategic purchasing conducted in the context of a large-scale automotive manufacturing environment. The PCRRM allows purchasing managers to lower and reduce risks at the key touch points of the purchasing process. This cost/risk reduction is achieved by steering practitioners through three clearly defined and critical stages of purchasing best-practice, namely; the

identification of corporate social responsibility risks, the reduction of sourcing costs, and the reduction of inventory holding costs. The methodology brings together these three purchasing themes into one holistic process that rigorously analyses, reports, refines, and implements strategic purchasing. The PCRRM is realised through seamlessly joined data modelling, questionnaires, evaluations, reports, and guides. The contribution takes the form of work-flow which is designed to be both useful and usable. The feasibility of this contribution has been demonstrated through two periods of validation in which both the individual studies and the holistic methodology have been evaluated. An equally practicable and holistic methodology is absent from the current body of published research and therefore the findings presented in this thesis provide a substantial contribution to knowledge for both the research community and industrial practitioners.

1.7 Thesis structure

This section gives an outline of the thesis structure. The work is presented in 10 chapters as shown in Figure 1-2. A summary of each chapter can be found below.

- Management Issues
 - Reviews the environmental context of strategic purchasing. A comparative analysis at the macro and micro levels is provided to highlight the role that manufacturing plays in the economy. The fortunes of the sponsor company and their key rivals are also discussed to add context.
- Literature Review
 - Provides a comprehensive review of seminal and cutting-edge works and explores the current issues facing strategic purchasing. The key terminology and themes of purchasing research are defined. The chapter moves from aggregative description though to critical analysis. Gaps in the body of knowledge are identified and a new theoretical strategic purchasing methodology is outlined.
- Research Programme
 - Discusses the key approaches and challenges of conducting purchasing research, particularly as they relate to the Engineering Doctorate. The main philosophical approaches and practical approaches of research are defined and compared. The aim and objectives of the research are finalised and an appropriate research programme is developed and justified.

- Development of the Skeleton Methodology
 - Describes the development of a skeleton methodology for reducing costs and risks in the purchasing operations of a large automotive manufacturer.
- Corporate Social Responsibility Study
 - Describes the development of the corporate social responsibility assessment process. Initial validation is provided through the analysis of results recorded during the implementation in the context of the sponsor company.
- Sourcing Study
 - Describes the development of the supplier selection and price reduction process. Initial validation is provided through the analysis of results recorded during the implementation in the context of the sponsor company.
- Inventory Study
 - Describes the development of the partner selection and inventory reduction process. Initial validation is provided through the analysis of results recorded during the implementation in the context of the sponsor company.
- Validation
 - The populated PCRRM is evaluated by an expert panel consisting of industrial practitioners and academics. The final stage of validation is provided through the analysis of interviews with the experts.
- Discussion and Conclusions
 - Provides the concluding discussion of the research and results. The contribution to knowledge and the associated limitations are discussed along with recommendations for future research in this area.

1.8 Summary

This chapter has summarised the background to the research project and given an overview of the development and execution of the research programme. It has also provided a summary of the thesis structure and the contribution to knowledge that this Engineering Doctorate has realised.

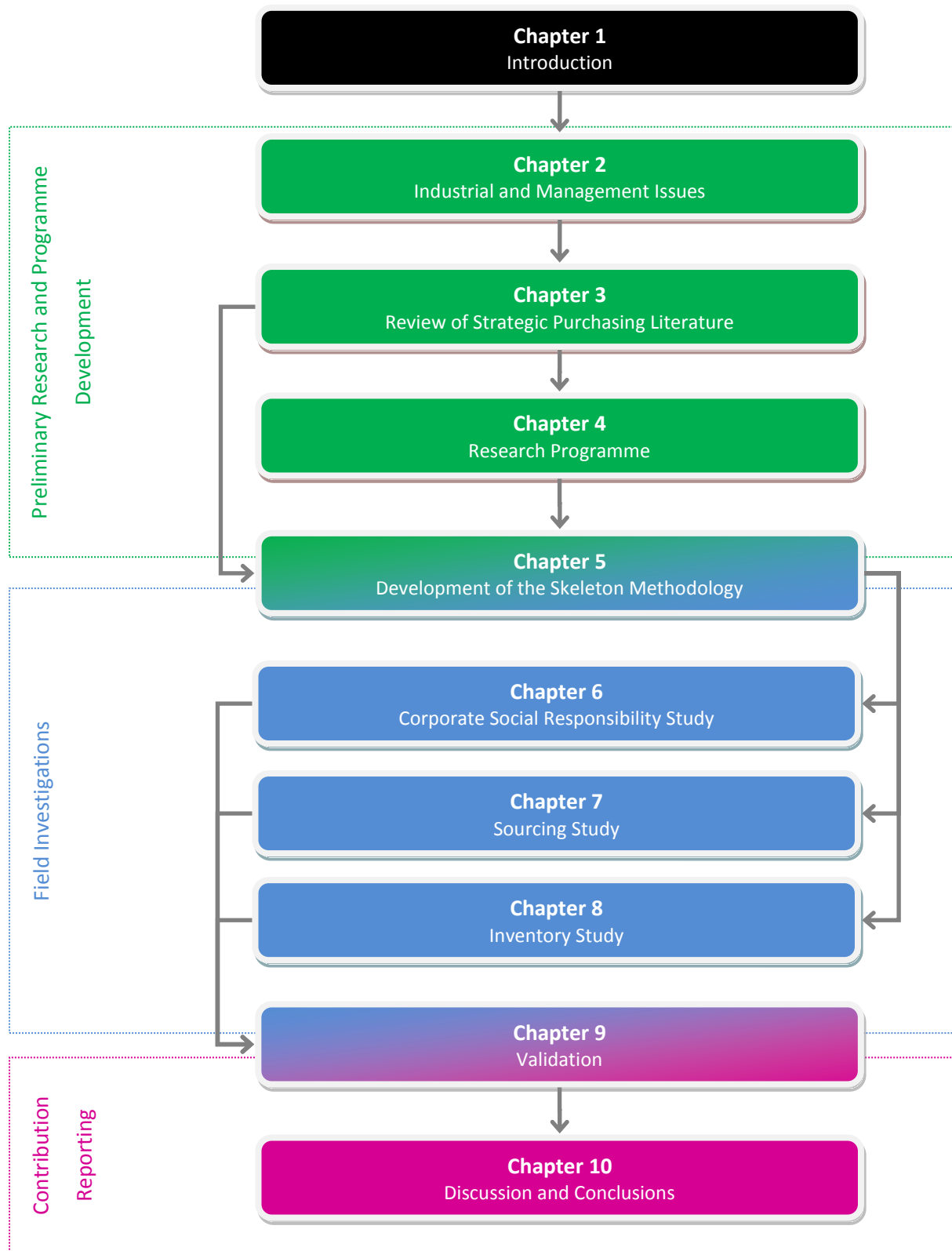


Figure 1-2. Thesis structure

Chapter 2

Management Issues

2.1 Introduction

This chapter presents a review of the key industrial and management issues directly impacting on large UK automotive manufacturers such as the sponsor company. To do this it addresses both the macro/international and micro/industry-level trends and discusses how these influence the operations of purchasing functions and processes.

This chapter is distinct amongst those that make up this thesis both in terms of the process of development and the ultimate purpose. A key requirement of the Cranfield Engineering Doctorate Programme is to demonstrate that the author has taken into account pertinent management issues which both inform and arise from the research. The management issues discussed here have been identified by reviewing analysis and papers from specialist business and industrial publications as well as through the management modules undertaken at the Cranfield School of Management

2.2 Chapter Structure

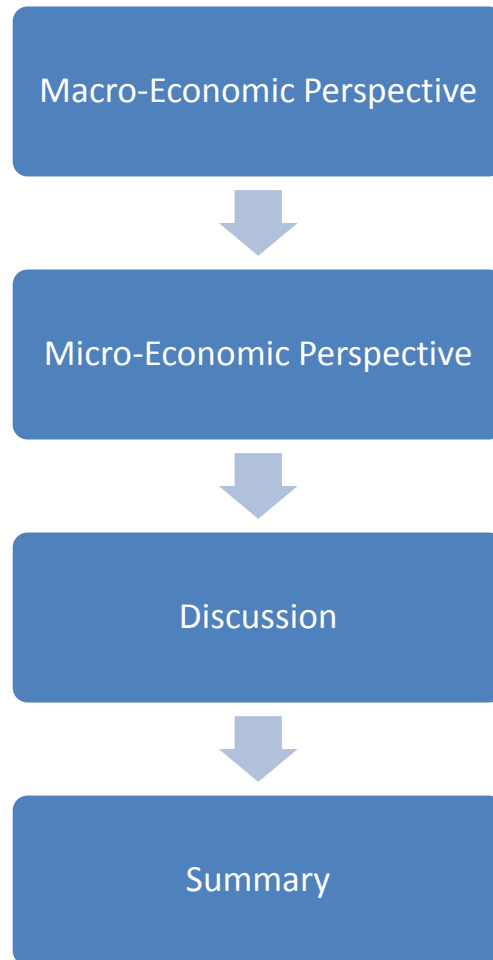


Figure 2-1. Chapter structure

2.3 Macro-Economic Perspective

This section discusses the influences and pressures which define the environment in which the large automotive companies operate. Macro level influences and drivers are those which are most heavily influenced by large multi-national and multi-regional political and economic policies. Examples of bodies which have some of the greatest influence are the European Union, the European Central Bank, the United States government, the US Federal Reserve, the World Bank, the International Monetary Fund, the government of the United Kingdom, and the Bank of England.

This section pays particular attention to the outcomes of the policies set by the bodies above and how these outcomes can be interpreted as opportunities or otherwise by some of the most substantial manufacturing organisations in the world. More specifically, in this section, the author provides for the reader a systematic analysis of the most important economic measures which are at play in today's challenging market place.

The International Financial Crisis and subsequent economic recession has been particularly difficult for the manufacturing industry, and its impact is being and will continue to be felt for many years. It is therefore tempting to associate the current structural changes in the industry entirely with the recession. There are however more fundamental and longer-term forces at work, and to attribute all or even most of the difficulties being faced by manufacturers (particularly those in the UK) would be counter-productive. When normal business resumes, the UK will be left with similar economic challenges to what it faced previously and while it is of course true to say that the financial crisis has been detrimental, this should not be equated with an expectation that all will be well post-recession.

International Trends

Industrialised nations have benefited from sustained positive growth rates since the late 90s. A dip in GDP rates around 2001 was a short-lived consequence of the .com bubble bursting; the following years saw a swift recovery across most sectors. Manufacturing conducted in the Western Nations, particularly the UK, was not however without its difficulties. Asset and commodity prices put pressure on bottom lines and squeezed profit margins. Despite the difficulties faced by the manufacturing sector, while the UK economy had sustained growth over this period. UK based automotive manufacturers were hit hard by the structural adjustments in the economy. Manufacturers have been hit by falling sales, increasing prices, and increased competition.

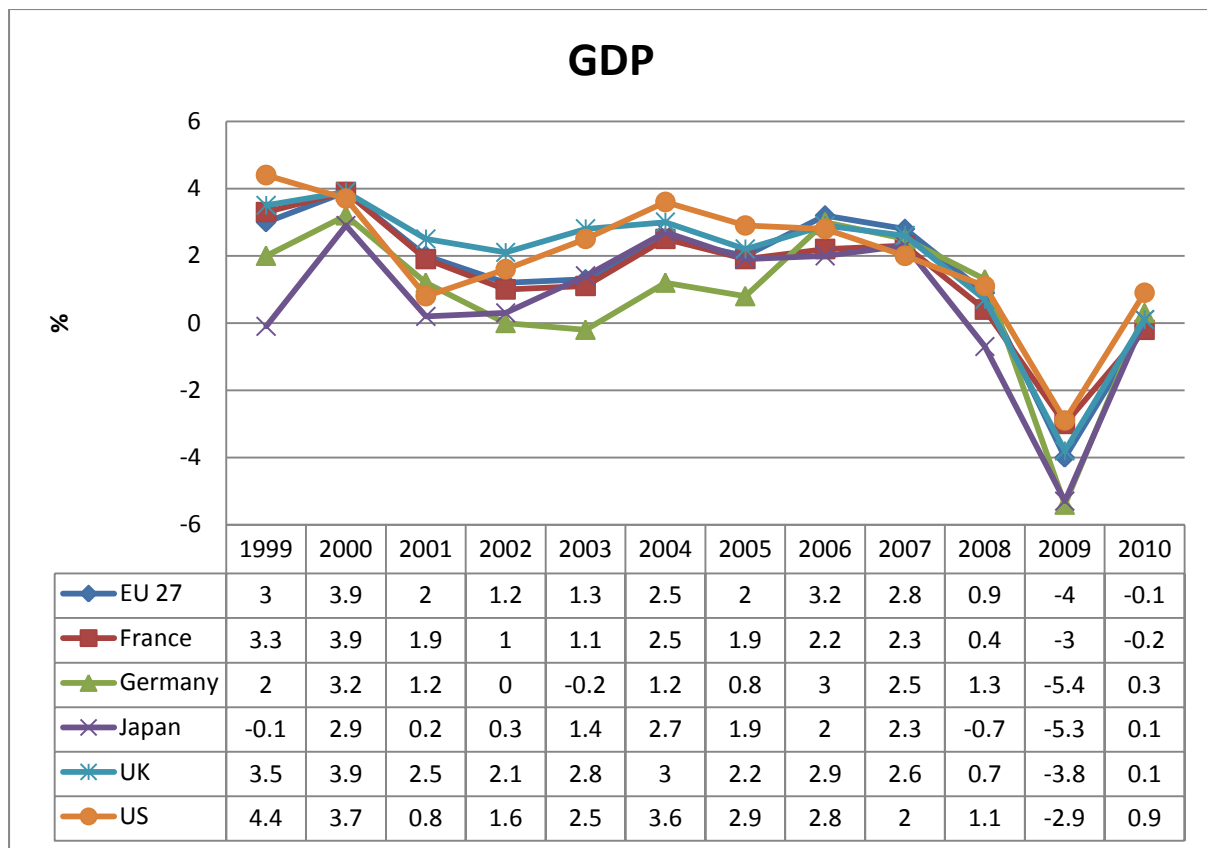


Figure 2-2. Real GDP growth percentage change year on year. Industrialised nations

Figure 2-2 and Figure 2-3 show that the developing nations of Eastern Europe have enjoyed higher growth rates than their industrialised counterparts for at least a decade. However, this higher growth rate has been mirrored by an equally impressive decline of growth into the negative. Unsurprisingly the changes in economic performance closely relate to those of the industrialised nations. These countries rely heavily on the consumption of their richer trader partners in order to fuel economic growth. The International Financial Crisis severely disrupted this consumption leading to a drastic decline in demand for products and services produced in low-cost economies.

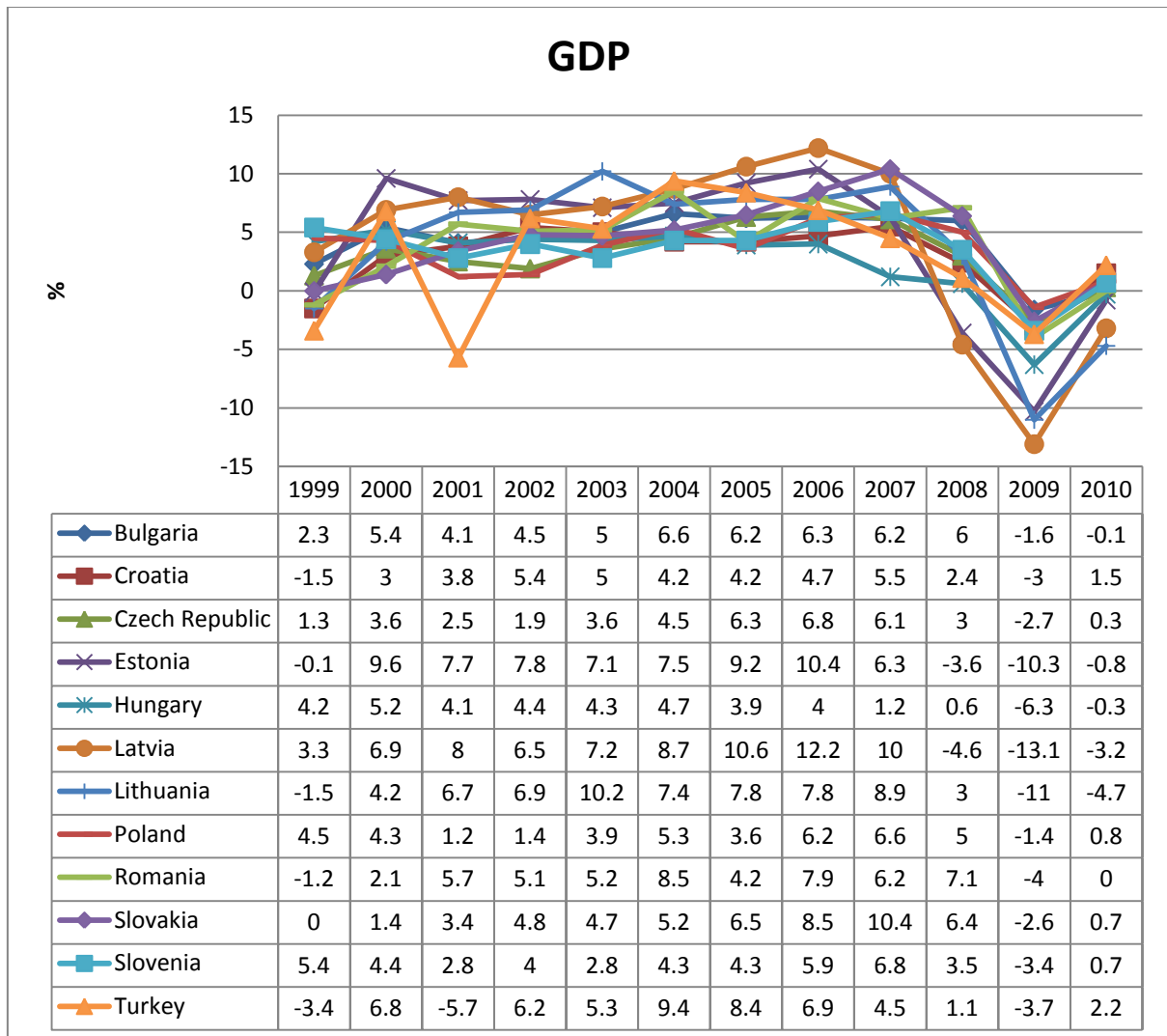


Figure 2-3. Real GDP growth percentage change year on year. Developing nations

There has been a strong trend to move increasingly sophisticated manufacturing jobs towards Eastern Europe (Figure 2-4). The cost base is significantly lower, with a young, productive, and well educated workforce ready to fill positions. The expansion of the EU eastwards has led to the normalisation of the competitive environment, meaning that there is today little difference between the UK and Eastern Europe (in terms of access to markets) for the location of a production facility. In addition, the EU has invested in infrastructure such as roads and bridges (as it did in Spain, Greece, and Portugal in previous decades) to encourage economic development in the region. With their proximity to the European automotive heartlands of Germany and Italy, countries such as the Czech Republic and Slovakia have seen an impressive increase in high-end manufacturing employment. This growth has coincided with a decline in such jobs in the UK. Germany, France, and Italy, all of whom are comparable to the UK in terms of market scale and technological advancement, have not seen such a decline.

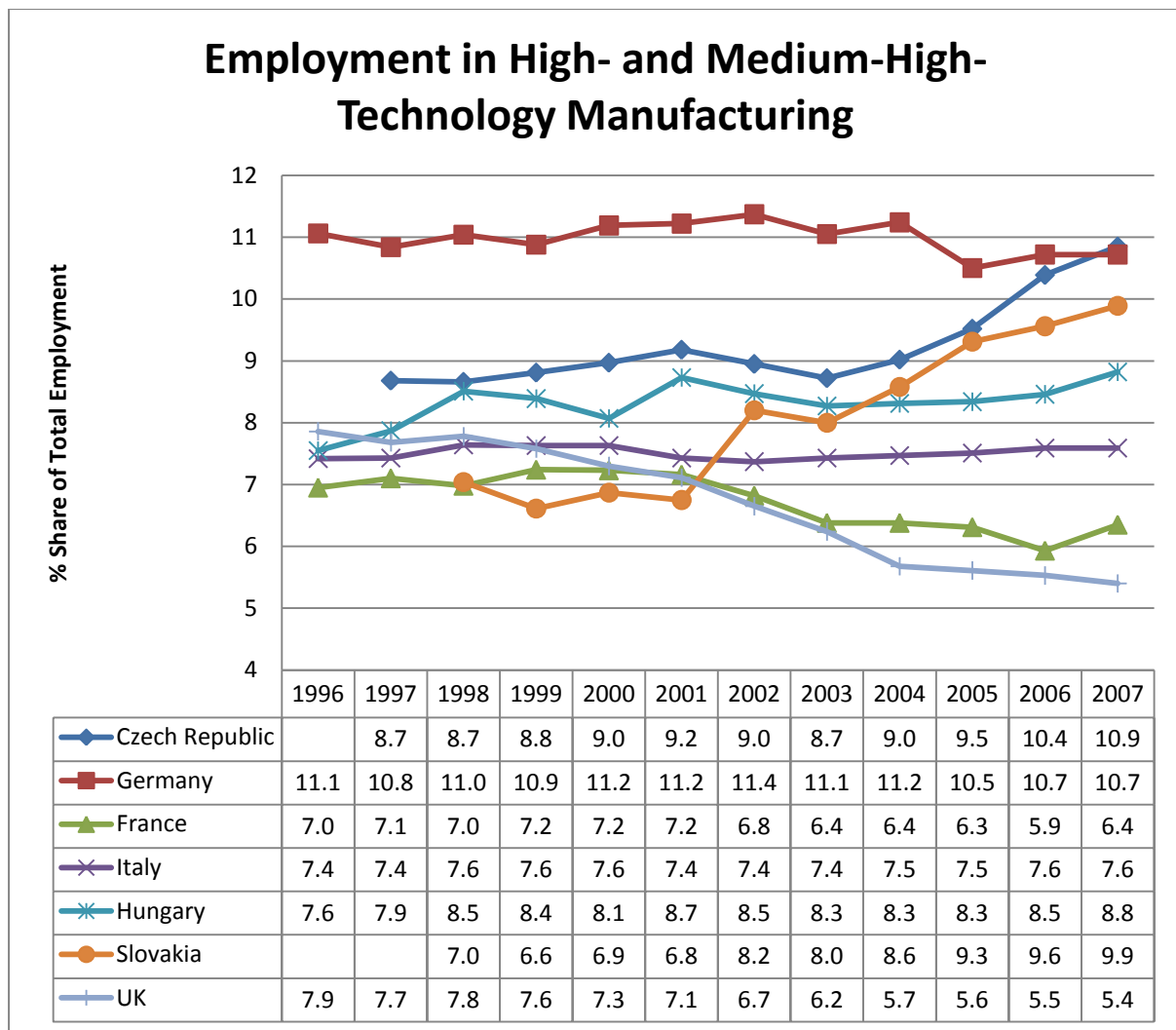


Figure 2-4. Changes in employment

The latter half of 2008 into 2009 saw a drastic slump in manufacturing turnover (Figure 2-5). This downturn was largely uniform across Eastern and Western Europe, with little separating the fortunes of manufacturers across the continent. This similarity in turnover reduction demonstrates the inter-connected nature of manufacturing. A fall in demand for manufactured goods (such as vehicles or aircraft) impacts on the manufacturers of production machines, machines spares, and consumable equipment etc. In addition the uniformity of the reduction in manufacturing also reflects the homogenous nature of manufacturing which is co-ordinated across borders. For example, automotive and aerospace manufacturers may well have developed specialised facilities in different economic zones (influenced by local resources and incentives), but despite this apparent differentiation a down-turn in the demand for the final assembled products impacts on all facilities. A reduction in vehicle production in a facility in one region will result in a matched reduction in the requirement for engines, wheels, glass, plastics, and steel.

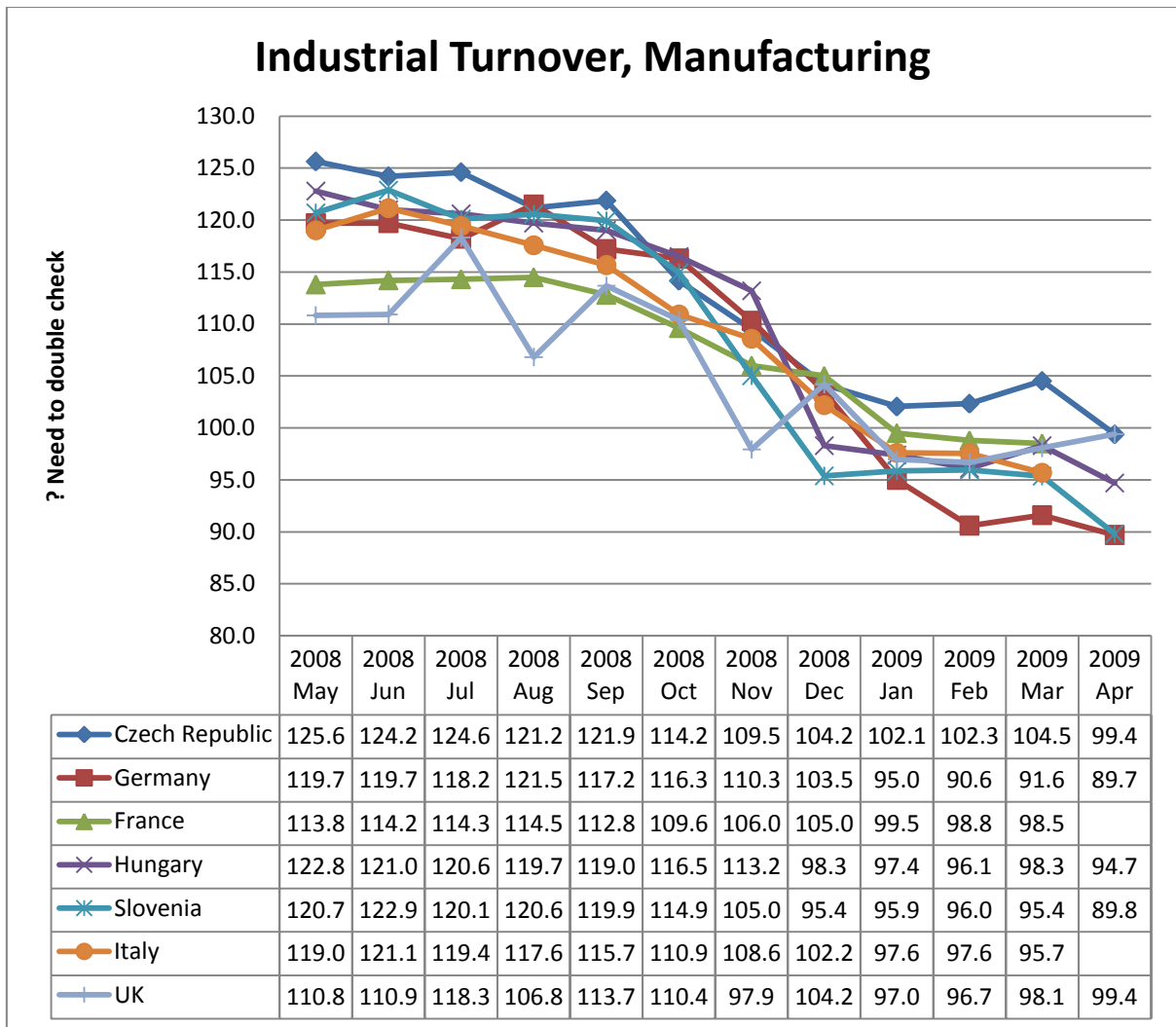


Figure 2-5. Manufacturing performance

The UK versus Rivals

The data presented in Figure 2-6 and Figure 2-7 would suggest that workers in the UK have consistently been less productive than their counterparts in other developed economies. The Government has in recent years invested in worker re-training and development schemes such as the New Deal, which are intended to enhance skills and encourage enterprise. This differential between the productivity levels of the workforce will influence the investment decisions in major automotive groups.

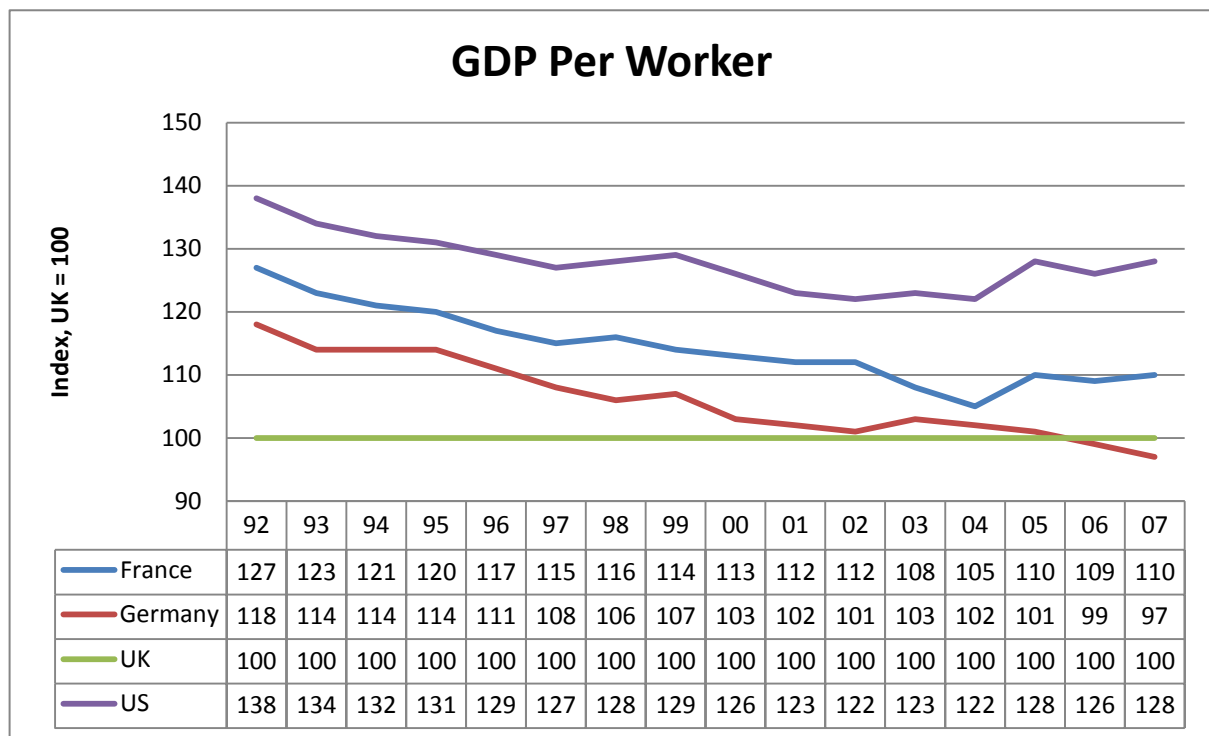


Figure 2-6. Comparison of gross domestic product per worker (Source: BERR)

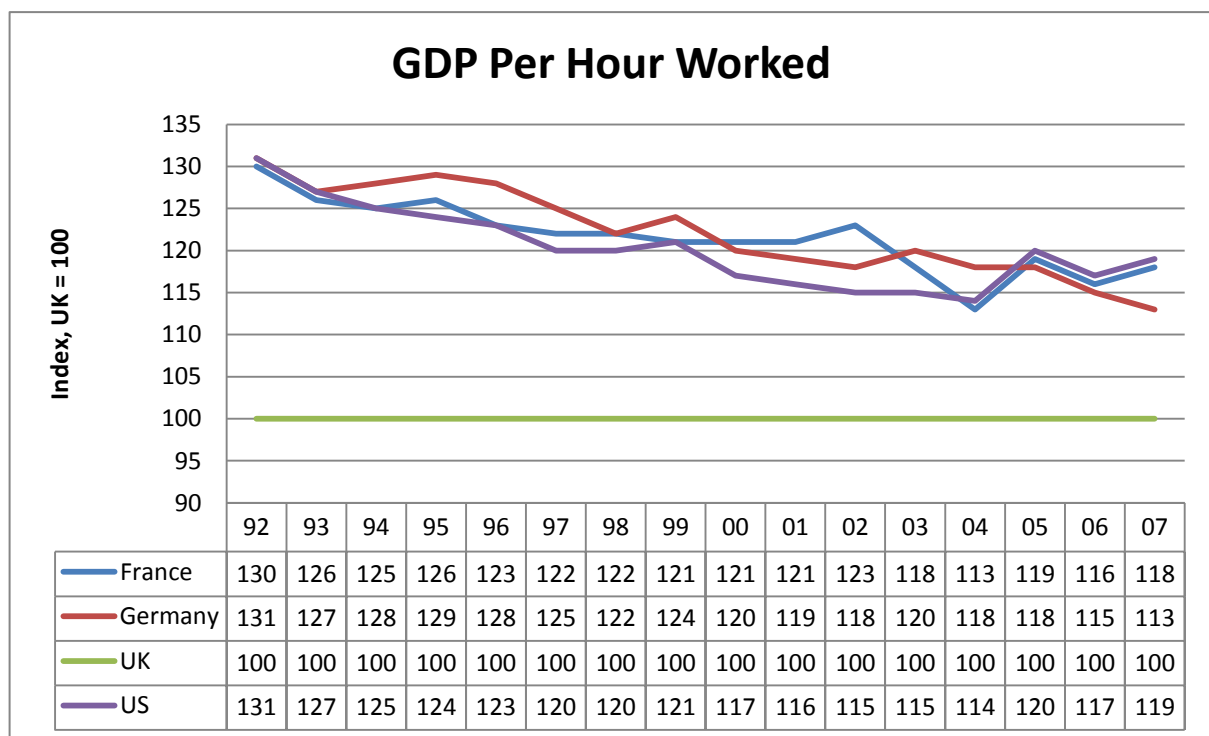


Figure 2-7. Comparison of gross domestic product per hour worked (Source: BERR)

Business investment is a key indication to the likely future competitiveness of domestic enterprises when compared against foreign rivals. What is clear from the data (Figure 2-8) is that at least as a proportion of GDP the UK has seen a sustained decline in investment since the late

90s. Between the years of 1997 and 2000 the UK invested relatively well, however since that time the UK has seen a decline in investment from business. In recent years the UK's business community has been unable or unwilling to invest to the levels of other developed nations. This can indicate that either the growth in GDP in the UK (e.g. in industries such as financial services) has outstripped that of its rivals to such an extent that investment has been proportionally lower, and/or businesses have chosen to maximise current profits to the detriment of investments (Figure 2-9).

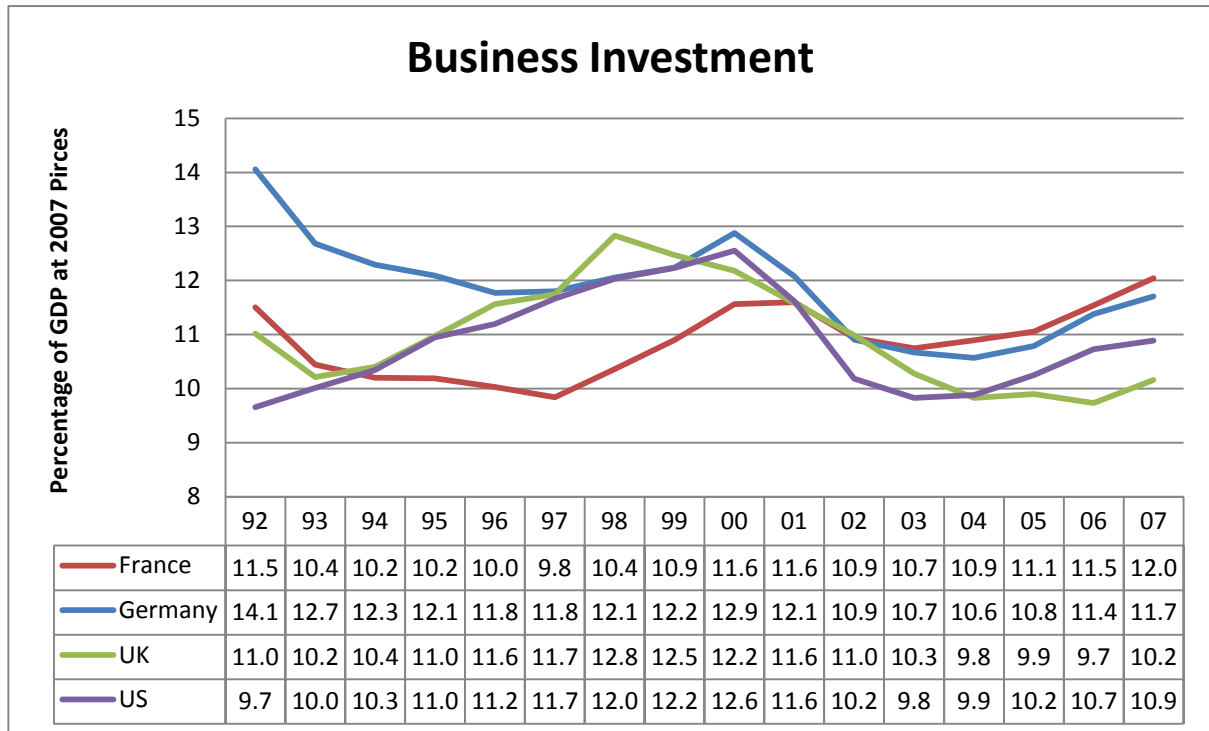


Figure 2-8. Comparison of business investment (Source: BERR)

As a proportion of GDP, the UK is consistently under-investing in R&D when compared to key international rivals (Figure 2-10).

The data uncovered as part of this analysis therefore paints a difficult picture for manufacturing organisations looking to invest in new operations in the UK. There remains a decline business investment, which has been mitigated through the increase spend from the public sector, although output from manufacturing has continued to decline. UK workers are less productive per hour worked, and spend on research and development is consistently weaker than that of close rivals. Despite this there remains a credible manufacturing base in the UK; the sponsor company is one such example. The challenge for them and others like them is to find a way of ensuring that these macro-level issues do not undermine otherwise viable businesses. Improving their ability to manage costs and risks in their purchasing operations will contribute to this effort.

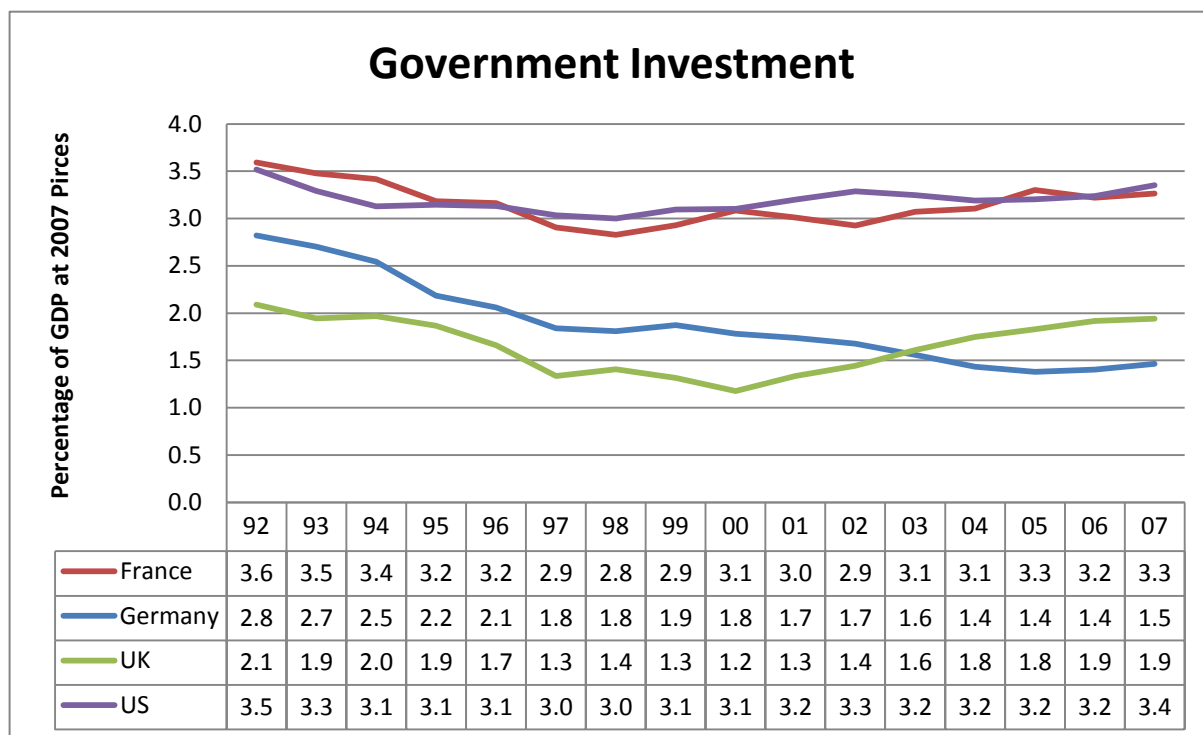


Figure 2-9. Comparison of government investment (Source: BERR)

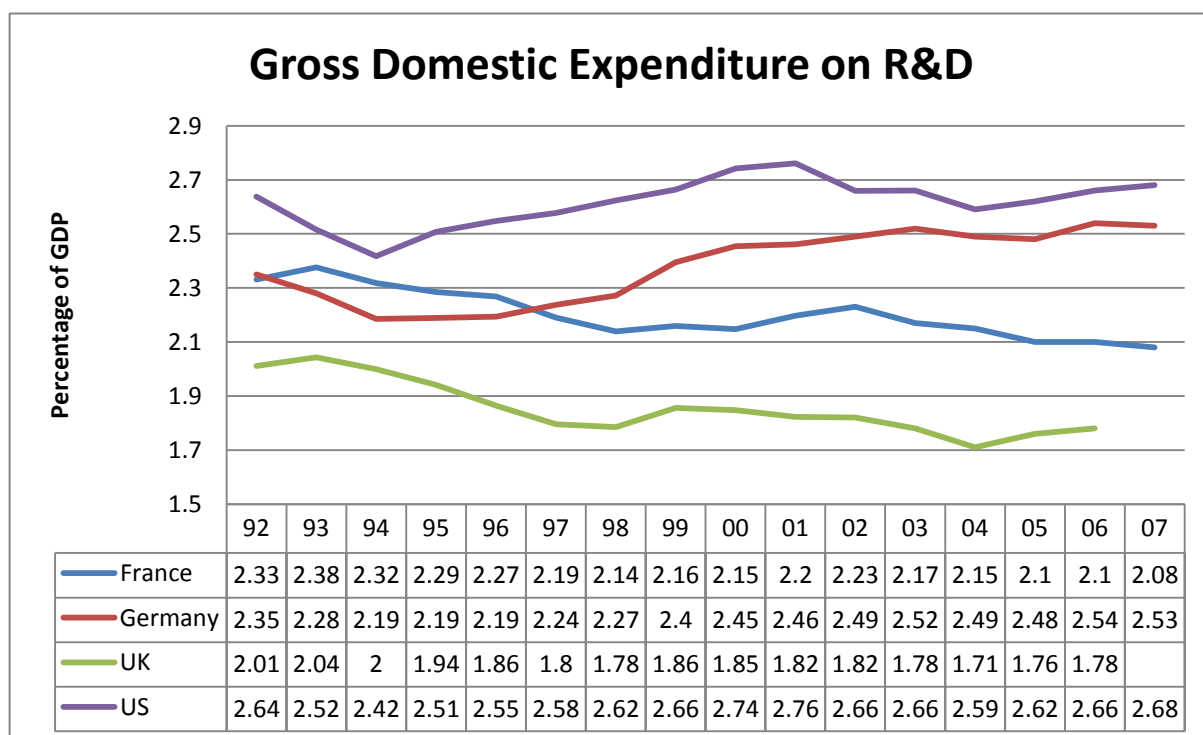


Figure 2-10. Comparison of gross domestic expenditure on research and development (Source: BERR)

2.4 Micro-Economic Perspective

This section discusses the influences and pressures which impact on the day-to-day competitive environment and the internal management planning of the sponsoring organisation. Micro level influences and drivers include automotive manufacturers operating with similar business models and producing products directly comparable to the company

The Automotive Industry

Japanese owned manufacturers are significant employers in the UK. The data shown in Figure 2-11 are directly employed personnel, and therefore does not include those directly reliant on the sustain operation of the manufacturing facilities. Such individuals include suppliers, cleaners, ground keepers, and construction workers. Those employed by and directly reliant on the plants also contribute to the wider economy through taxes and expenditure.

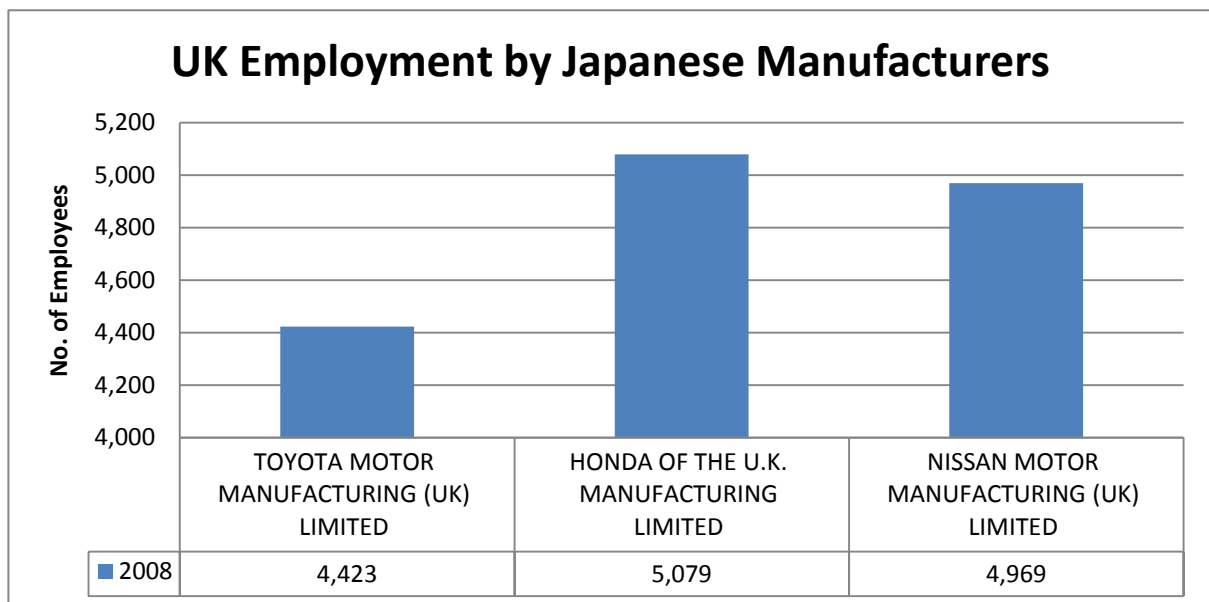


Figure 2-11. No. of Employees in Japanese Owned UK Automotives (Source: Amadeus)

As can be seen in Figure 2-12, new car sales have collapsed from the levels seen between 2003 and 2007. In fulfilment of this Engineering Doctorate, the author spent 2 ½ years conducting the research from the offices of the sponsor company. This change in the business environment was experienced first-hand. As a significant employer the sponsoring organisation and those like it, have a financial commitment to their employees and suppliers. However, the reality for the industry since the onset of the financial crisis has been depressed sales and therefore lower revenues. This situation has intensified the need to utilise those areas which may have previously been ignored, such as purchasing and supply functions, to realise cost savings.

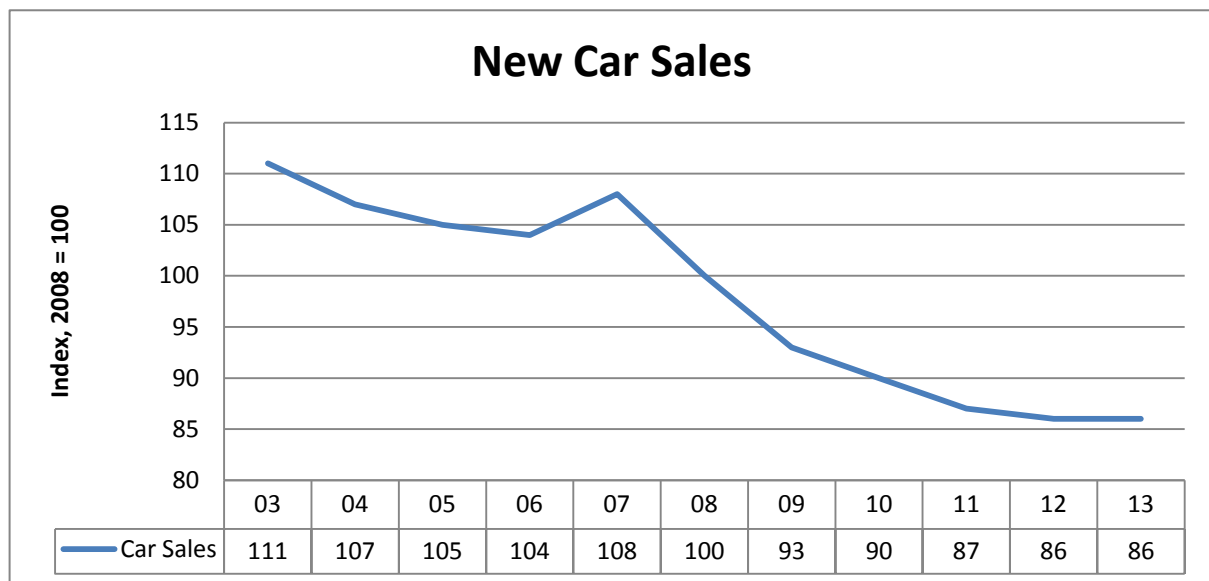


Figure 2-12. Year on year actual and estimated change in new car sales value (Source: Mintel)

Toyota Motor Manufacturing UK Ltd.

This section of the industrial context examination begins with a comparison of the sponsor company's reported financial accounts along with those of its chief expatriate rivals. The sponsor company of this research is Toyota Motor Manufacturing Ltd (here after TMUK). The chosen companies for comparison are Honda of the UK Manufacturing Ltd (here after HUKM) and Nissan Motor Manufacturing Ltd (here after NMUK). For the purposes of this analysis, the three companies compare well, with similar sized operations in the UK. All balance sheet and profit and loss account items are similar in scale, with the exception of profit before tax. It is not immediately obvious how NMUK has been able to report a significantly higher figure, given that other measures are so similar. It is likely though that this is the result of an exceptional occurrence, such as asset sales or temporary financial engineering.

Table 2-1. Toyota versus comparable rivals. Balance Sheet and P&L Account items. 2007

All figures are € thousands	Operating Revenue	Profit before tax	Cash flow	Total assets	Shareholders' funds
TOYOTA MOTOR MANUFACTURING (UK) LIMITED	3,488,277	11,638	163,393	943,941	321,082
HONDA OF THE U.K. MANUFACTURING LIMITED	3,425,841	13,085	164,687	1,090,978	427,834
NISSAN MOTOR MANUFACTURING (UK) LIMITED	3,786,819	100,527	268,321	1,598,381	636,621

Source: Amadeus

The current ratio compares current assets (available cash and near cash assets / liquid assets) and current liabilities (upcoming cash requirements). A value of more than 1.0 describes a business operating with a positive cash surplus. As can be seen from Table 2-2, in 2007 TMUK reported a less than favourable current ratio, and one which was significantly lower than HUKM and NMUK. This indicates a comparatively weaker financial position. However, this ratio may have been affected by short-term stock holdings, in addition recognising the difficulty in measuring the liquidity of inventories both HUKM's and NMUK's ratios may be distorted by some erroneous current assets.

Table 2-2. Toyota versus comparable rivals. Company ratios part 1. 2007

	Current ratio (x)	Profit margin (%)	Return on shareholders' funds (%)
TOYOTA MOTOR MANUFACTURING (UK) LIMITED	0.75	0.33	3.62
HONDA OF THE U.K. MANUFACTURING LIMITED	1.66	0.38	3.06
NISSAN MOTOR MANUFACTURING (UK) LIMITED	1.06	2.65	15.79

Source: Amadeus

Table 2-3. Toyota versus comparable rivals. Company ratios part 2. 2007

	Return on capital employed (%)	Solvency ratio (%)	Gearing (%)
TOYOTA MOTOR MANUFACTURING (UK) LIMITED	3.39	34.02	160.92
HONDA OF THE U.K. MANUFACTURING LIMITED	3.74	39.22	86.94
NISSAN MOTOR MANUFACTURING (UK) LIMITED	18.97	39.83	97.03

Source: Amadeus

What is most interesting in Table 2-3 is the gearing ratio. The TUMK figure indicates that a substantially larger proportion of the business has been fuelled by debt than that of its key rivals. In good times this has often promoted business development. However, when credit becomes more difficult to secure this issue can develop into a critical weakness in the business model and could under the most extreme circumstances pose a risk to the short to medium term viability of the business. It is not possible from this high-level analysis to confirm that such a risk has been taken, however the gearing ratio does suggest increased exposure to such possibilities, which can

only have added to management difficulties through some of the most pressing times in recent history.

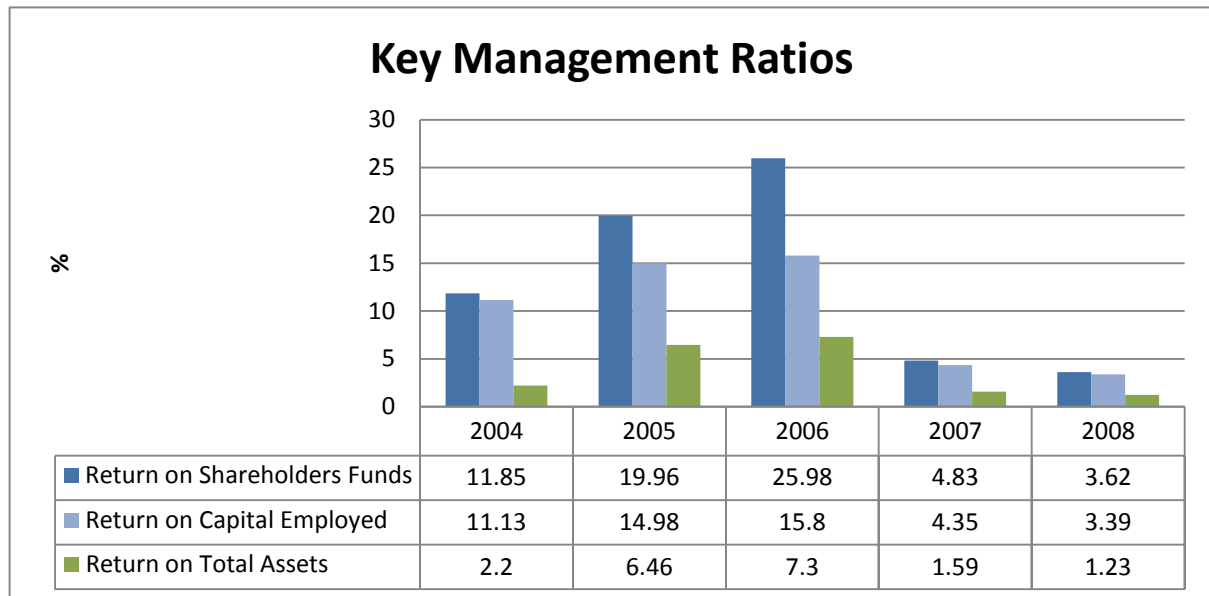


Figure 2-13. Key financial ratios for Toyota Motor Manufacturing UK (Source: Amadeus)

Figure 2-13 shows a clear trend between the years of 2004 and 2008. The years leading up to 2008 were some of the most prosperous for the country and in turn some of the best years to be in business as a manufacturer. Even given all of the difficulties discussed earlier in this chapter, manufacturers benefited from cheap credit and the cheap credit available to their customers. During this golden period the returns expressed through a number of key management ratios, including return on shareholders' funds, return on capital employed, and return on total assets, were rising.

2.5 Discussion

Automotive Manufacturing

Automotive manufacturing significantly contributes to the technological competitiveness of the wider manufacturing sector through research and development (BERR, 2009). The sector is regarded as critical to the long-term economic success of the UK economy. With around £9bn worth of exports (representing one eighth of UK manufacturing output), approaching half a million jobs are reliant on the industry (BERR, 2009).

In recent times, the industry has grown at 2.5% per year globally (BERR, 2009), with developing economies such as the BRIC nations (Brazil, Russia, India, and China) accounting for a significant share of this. In Western Europe, North America and Japan, growth has slowed. In line with this

distribution of demand the majority of new production capacity has been established in the BRIC nations and Eastern Europe.

In response to these difficulties, flexible manufacturing solutions are under development in an attempt to mitigate market fluctuations (BERR, 2009). In addition, investment in high technology solutions, including training elements of the workforce to a highly skilled level are being carried out to allow production facilities in the developed world to remain competitive.

The UK

In recent years, the sector has developed into a model example of good labour relations and quality manufacturing (BERR, 2009). This contrasts sharply with the image of the automotive production in the 70s and 80s which saw regular plant closures due to strikes and a fall in product quality. Vehicles produced in the UK at companies such as Toyota are recognised as being amongst the most reliable in the world. Prior to the economic downturn now engulfing the industry, in the UK and across the EU, automotive manufacturing was a profitable and sustainable enterprise (BERR, 2009). The move to produce greener vehicles has seen unprecedented investment in clean production technologies and a drive to produce more fuel efficient vehicles. In 2008, 1.65mn vehicles and 3mn engines were produced in the UK. However, employment has been in decline as more efficient means of production have been developed.

Current Issues

Across the board there has been an acceleration of cost reduction activities due to the extremely difficult economic climate. In the short-term, this has been geared towards mere survival, but there is a recognition that changes need to be made that will positively impact on the medium-term viability of the sector. There has been a spate of temporary plant closures and production slow-downs, with non-permanent workers being the first to face job losses. There has also been significant and in some cases intolerable pressure on Tier 2 and 3 suppliers. With production falling so sharply the needed inputs, such as general consumables, have fallen. There is the real possibility that this effect will cause long-term damage to the industry requiring producers to look elsewhere when production does return to normal levels.

The UK is ranked twelfth in terms of production output, accounting for around 2.5% of global output. On a Europe-wide basis the UK has consistently ranked fourth behind France, Germany, and Italy. The industry accounts for over 3000 businesses registered in the UK, with over £10bn in value added per year (BERR, 2009). Manufacturing as a whole accounts for around 10% of jobs in the UK, and around 6% of manufacturing jobs are in the automotive sector (BERR, 2009).

The automotive sector contributes to the economy through the employment of tens of thousands of direct and indirect workers. The compensation paid to these workers positively impacts on regional and local businesses, providing further jobs in the economy. However, between 1997 and 2007 the industry lost over 100,000 jobs, which is just under 5% per year (BERR, 2009). In line with this the proportion of people employed in manufacturing has fallen from 6.6% to 5.9%, and as a proportion of total employment from 1.1% to 0.6% (BERR, 2009). This is a more severe decline than for manufacturing as a whole, which over the same period fell from 16.6% to 10.5% of jobs in the economy (BERR, 2009). During this period output has been able to increase. This contrast may be in part due to the increased use of out-sourcing of non-core operations to non-permanent workers, along with more efficient means of production. However, the reduction in jobs in the sector as a whole cannot be entirely accounted for in this way, with job losses in the supply chain bearing the brunt of the reductions.

While the automotive sector remains to be a worthwhile contributor to employment in the UK, it is losing scale and relative volume to competitors abroad. In particular, there is continued pressure on the supply chain, meaning that local sourcing of inputs may not be possible over the medium to long term. Plant and supplier closures in the UK are disproportionately high, with a move away from large-scale commodity type vehicles to niche/premium brands. This key differentiation has enabled the UK to maintain a comparative advantage. However, this has had a knock-on effect to the supply base. Suppliers have lost scale meaning they are less able to compete internationally. The contribution to economy has not grown as quickly as other sectors, and currently accounts for around 0.7% of GDP (BERR, 2009). And although the recent economic downturn has undoubtedly impacted on this, the trend has been evident for some years. In general, there has been a move towards low-cost manufacturing in developing nations. European countries such as Turkey and Poland have seen much of the new investment in production facilities, with the associated investment in parts supply operations. The level of the UK's contribution to global automotive output is falling faster than that of other developed nations such as Germany and France. There has also been a consistent fall in the components supply business. At least 50% of the value of a vehicle is sourced from suppliers, so the sharp decline in the UK supply base is likely to have long-term negative effect on the ability of domestic manufacturers to compete at the international level.

Risks to the UK: Over-Reliant on FDI?

The recent International Financial Crisis and subsequent recession has highlighted the risks associated with reliance on foreign direct investment. It is exceptionally difficult to offer proof

that international organisations are actively seeking to protect their home nation operations for political reasons. The only means through which such proof could be gathered would be through a deliberate leaking of high-level documents. It is reasonable to argue that under the most serious economic downturn in recent history the decline in demand for high value goods such as cars has left international manufacturers with difficult decisions to make. None more so than which production facilities should they maintain and for how long. It is no secret that many governments, including those of the EU, US, and Japan engage in subsidising, or near-subsidising practices. This is a useful lever for governments and it would be remarkable if this did not figure somewhere in the calculation. If this point is accepted, it is then appropriate to ask how this might impact on the manufacturing in the UK. There are no large-scale automotive groups with headquarters in the UK. The big employers such as Toyota, Nissan, Honda, Ford, and Vauxhall are all foreign owned companies. Under normal conditions, this is perhaps an issue of little concern (beyond a discussion about corporate tax revenues etc). However the recession has brought to the forefront concerns over the UK's exposure and what could be called an over-reliance on foreign employers and while far many of the most worrying concerns have not yet been realised this does not mean this is an issue that can be ignored by those charged with the responsibility to strengthen the UK's manufacturing base.

2.6 Summary

This chapter has presented the findings of a review of the key industrial and managerial issues which impact on large UK manufacturers. In doing so it has addressed both macro and micro trends which form a difficult trading environment for automotive manufacturers such as the sponsoring organisation.

Manufacturing in the UK is under pressure from lower cost economies. Reducing costs in the purchasing function will be a positive step in regaining competitive advantage. The Toyota Motor Manufacturing UK also has a number of sister companies across Europe. Their manufacturing facilities in both Poland and Turkey are substantially cheaper operations. It is therefore of great importance to Toyota that they are able to find methods to equalise their cost base.

Chapter 3

Literature Review

3.1 Introduction

The purpose of the research presented in this thesis is to assist purchasing and supply chain managers and their staff to reduce costs and risks in their supply and inventory base. This chapter fulfils a number of functions in meeting that aim.

Following from this introduction, the reader will find the main concepts and definitions most commonly used by the research community that place the field in an historical context. The major themes and ideas of the field are reviewed and discussed. Figure 3-1 gives a conceptual representation for the structure of this chapter

3.2 Chapter Structure

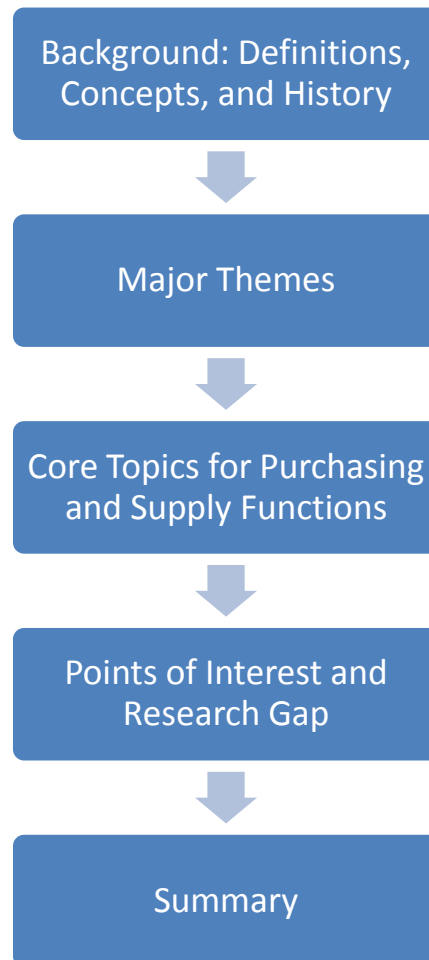


Figure 3-1. Chapter structure

Conducting and writing this review has provided the author with a set of knowledge and tools from which to understand the problems and opportunities in the field. This researcher has found this process to be worthwhile and rewarding endeavour. The techniques, theories, and findings of others provide a rich collage of information from which research designs and hypotheses can be generated. Ultimately, this process directly supports and contributes to the establishment of a contribution to knowledge.

There are many approaches taken by the research community in understanding purchasing and supply chain management, which in turn means there is a rich resource to draw upon. The obvious down side to this is that any exhaustive review would be very much longer than the limit placed on the entire thesis, not to mention the physical time required to read and report such a volume of material. With this in mind, it was proper that the author focus this review on to the most significant and relevant papers, and pay closest attention to the works of those researchers which offer the greatest insight into issues similar to those discussed in this thesis.

3.3 Background: Definitions, Concepts, and History

The purpose of this section is to provide the reader with an understanding of the major concepts and definitions used in purchasing and supply chain management research along with some historical context.

This section begins by first defining the terminology most commonly used by key researchers in the field. When taken as a whole, the body of research contains a number of contradictory, overlapping, or inconsistent uses of terminology. Therefore it is important for non-specialist readers to avoid misinterpreting the discussion by setting the language and meanings in a clear and understandable format. In addition this section gives an overview of the historical context into which this review sits. A number of very interesting early works are discussed which enrich the understanding of the subject as a whole, while also demonstrating the development the field has undertaken in recent years.

Definitions

There is an inconsistency in the usage of the key terms relating to this field, or to put it another way, terms are frequently substituted (Table 3-1).

Table 3-1. Definitions of Purchasing

Author	Definition
Gadde and Håkansson (1994)	Assists in the make or buy decision, formulates the supply base structure, and implements buyer-supplier relationship management
Carr and Smeltzer (1997)	Plans, implements, and evaluates strategic purchasing decisions consistent with the business' long-term goals
Karpak et al. (2001)	Manages the supply base including formulating selection criteria and monitoring supplier performance
Stanley and Wisner (2001)	The primary boundary-spanning function which acts as an internal supplier mediating between suppliers and other areas of the business
Chen et al. (2004)	Contributes to corporate planning process, facilitating organisation to environment alignment, and integrates supply-chain activities across the business
Andersen and Christensen (2005)	Manages a network of procurement channels delivering leading technology and cost-efficient supplies
Cousins et al. (2006)	A strategically focused process ranging from tactical buying to strategic supply chain management. Creates sustainable competitive advantage by responding quickly and efficiently to market changes

Purchasing can be viewed as a function. In this function, purchasers use a combination of knowledge, experience and resources to perform a specialist task. The purchasing function can be viewed as both an entity (such as a unit or a department) or as the acquisition of inputs. In many businesses, purchasing remains a discrete department. Competition is in some circumstances forcing businesses to look at integrating it with other functions such as logistics, material and supply-chain management (Lysons and Farrington, 2006).

Purchasing can act as a sequence of tasks or stages leading to the acquisition of inputs (Figure 3-2). Within this process, each stage is responsible for the capture and processing of relevant information. This information at each stage is used to realise the ultimate objective of obtaining supplies (Lysons and Farrington, 2006; Fiestras-Janeiro et al., 2011).

1. Receive Requisition
2. Solicit Quotations
3. Negotiate with Suppliers
4. Place Order
5. Receive Supplies
6. Make Payment

Purchasing may also be viewed as a link to the wider value chain, along with production, logistics and inventory control. In this way purchasing becomes an activity that supports the creation of competitive advantage (Lysons and Farrington, 2006).

Purchasing is sometimes referred to as a series of personal and organisational relationships between parties acting in a significant number of transactions over time. Internally to the business these relationships might involve the initiator of a purchasing request and a person processing the request. Externally, these relationships might take the form of a buyer and their counterpart in the supplier business (Lysons and Farrington, 2006).

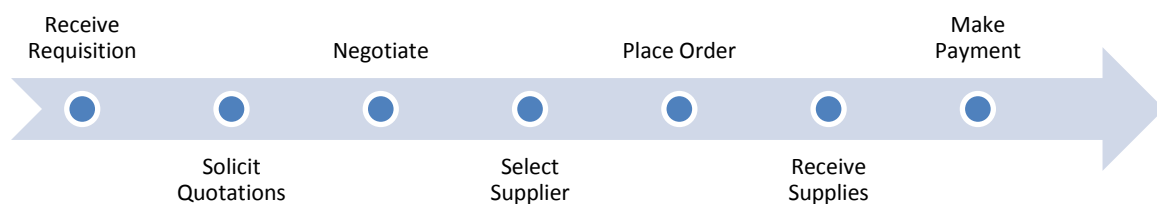


Figure 3-2. A typical purchasing process

Purchasing and Supply

The acquisition of timely supplies of inputs is the central task of purchasing and supply management. In some industries it can prove exceptionally difficult to ensure reliable supplies and for any business to compete effectively the lack of timely and reliable supplies can hinder its

ability to compete effectively (Ottesen and Gronhaug, 2002). This means that purchasing and supply management can play a leading role in ensuring the viability of a business. Tan (2001) identifies in the literature a change in the view of purchasing role. As one would expect it is most frequently related to supply activities of manufacturers but more and more often it is being seen as a value-adding operation in the flow of materials and goods from source to consumer (Tan, 2001).

Recent years have seen the traditionally narrow role of purchasing and logistics blossom into a much broader holistic and strategic business function (Tan, 2001). To get there, purchasing and supply management require re-orientation to position the function at the centre of business strategy. This will only be possible if the skills of the purchasers are enhanced along with greatly increased information and communication flows (Anderson and Rask, 2003). Guinipero et al. (2005) surveyed purchasing and supply-chain managers and found that in general those that acted enterprisingly had the skills to encourage creativity, flexibility and other value adding traits. The indications of their work are that the business environment is changing so quickly that a new set of skills is now fundamental for purchasers. The relative entrepreneurial abilities of purchasing managers are a good measure of flexible skills as it implies the inclusion of good risk management, decision making, interpersonal and planning skills (Guinipero et al., 2005). Entrepreneurial skills are important in the adaptation of the purchaser to environmental changes and thus to supply-chain flexibility. The most flexible managers are those with more persuasive and influencing skills and these managers assist in achieving wider supply-chain flexibility (Guinipero et al., 2005).

Satisfying market demand is determined by a business' ability to manage uncertainty; supply uncertainties are key amongst these, and therefore profit is not created only through factors under the control of competitors but is instead a measure of a business' ability to anticipate supply fluctuations (Ottesen and Gronhaug, 2002).

Integrated supply now being of key importance requires all members of the chain to invest and commit extensive resources (Tan, 2001). Considerations of the information systems they use are needed. Increasingly, purchasers will be required to adapt, requiring flexibility in approach taken to problem solving (Anderson and Rask, 2003). There is a big shift underway in purchasing and supply domain, with a move from traditional inventory based flows to information flows (Anderson and Rask, 2003). This is a significant change in the mindset and will require new methods and processes in order to exploit the opportunities and risks associated with this

change. Stakeholders in this scenario will increasingly find that mediation between the parties is critical to their success (Anderson and Rask, 2003).

To understand these information and communication flows, systems that can give a clear overview will be needed as an increasingly complex web of relationships is built (Anderson and Rask, 2003). These systems will likely take different forms depending on the specific context; however it is clear that such systems will prove invaluable to purchasing managers as they traverse the delicate path between day to day management of the acquisition of resources and the longer-term strategic decisions they will need to take to remain competitive. The financial implications of making changes to established value chains can be substantial and are an evident attraction for organisations such as large manufacturers. On the negative side, these information flows and changes in the value chain may lead to the business becoming overly reliant on particular suppliers (Tan, 2001). This concern is an important consideration in industries where over reliance on a limited but powerful supplier base could undermine flexibility and increase risks. It is however understandable that an organisation under already severe cost restriction will seek to share the burden with their supply partners and those larger suppliers are obviously more capable of making investments in this area. An additional concern is that as close relationships develop between actors in the supply chain there may be opportunities for trade secrets to be passed to third parties or indeed suppliers could exploit this information to develop further capabilities for themselves (Tan, 2001).

Historical Context

It is important for any review of the literature base to offer the reader the historical context into which the main body of the analysis fits. As will become evident later in this chapter, unlike many of the hard sciences, the focus on purchasing and supply chain management as a distinct discipline is a relatively new phenomenon. However, it is not correct to assume that previous researchers have not considered the themes and issues pertinent to purchasing. In conducting this review, the author has identified two interesting papers from much earlier periods than the majority of those reviewed and analysed in later sections.

Job (1908)

Rather interestingly the first of these papers was published in 1908 almost a full century before purchasing came to prominence as a field of research. What stands out most when reading Job (1908) is how the issues relevant to that time period are remarkably similar and in large part identical to those facing businesses and organisations today.

Job (1908) begins by informing us that “the purchase of the supplies of a large corporation under present-day conditions has become a most important factor in the successful conduct of the business”. Job (1908) also tells us that price should not be viewed as the determinant factor of quality. By today’s standards this seems rather obvious but it is clear when reading the full paper that the reader of the day may not have automatically shared this view. This issue identified by Job (1908) all that time ago is one of the key foundations of purchasing and supply chain reasoning. Job (1908) pursues this idea further to argue that in fact price may bear inverse relationship to quality. Taken together these two ideas are of tremendous importance to the development of the field in more recent years. Essentially what Job (1908) identifies for the first time is that businesses not only can, but indeed should look to resource their supplies from cheaper sources, not only because the higher prices of some suppliers may not be justified, but also they may (although not always) be a reflection of poor performance. Furthermore Job (1908) adds, “some articles largely used are manufactured and sold under trade names, and often the price is out of all proportion to the true value”. This statement will undoubtedly resonate with any purchaser or indeed general consumer of today. It is fascinating to think that even in the early days of branding this concern was so identifiable.

Job (1908) continues to set out some of the basic tenants of purchasing that would develop into the modus operandi of practitioners in modern businesses. Quality, it is argued, should be determined based on results, and that the purchaser should establish means to test and measure these specifications and expected results. As well as this, purchasers (according to Job (1908)) should only seek to purchase inputs which offer the essential properties for successful operation in order to avoid unnecessary costs. That is to say, that unless an input contains the essential qualities for successful performance it is useless and a wasted investment regardless of whether is of otherwise high quality. Again, to the modern reader this seems glaringly obvious but for Job (1908) to have identified this as a need shows that in the climate of the day these methods may not have been so widely practiced.

Further to these findings, Job (1908) argues that the analysis of waste materials is an essential part of cost reduction. Job (1908) continues this idea by stating that failures in service should be analysed in order to formulate strategies to avoid such occurrences in the future. The Toyota Production System amongst other lean and/or process improvement methodologies uses these concepts as a key driver for improvement.

Job’s statement might be summarised as:

- The right product
- In the right place
- For the right price

Kraljic (1983)

The second paper to offer some historical context to the rest of this chapter is that of Kraljic (1983). Published by the Harvard Review, this is one of the most widely cited papers in the field and regularly appears in reviews of the field for the important reason that it is almost certainly the first serious attempt to conceptualise the issues and approaches to improving purchasing performance to appear in the literature base.

Kraljic (1983) begins by framing the discussion in the turbulent time of the early 1980s with the following quote:

“The stable way of business life many corporate purchasing departments enjoy has been increasingly imperilled. Threats of resource depletion and raw materials scarcity, political turbulence and government intervention in supply markets, intensified competition, and accelerating technological change have ended the days of no surprises” Kraljic (1983).

And in case the reader of the day was to wonder just how important purchasing and supply management was to become, Kraljic (1983) states clearly that as uncertainty across all the variables of a modern economy increases, purchasing and supply management become of greater significance.

As with Job (1908) the similarities that these statements have with the current economic and business climate is remarkable. And given that these statements in the early 80s have such resonance with those of today, it adds to the notion that purchasing’s challenge is not new.

Kraljic (1983) goes on to put the case that purchasing can no longer be regarded as a purely functional endeavour, and must step forward and provide strategic leadership and contribution to the wider business. According to Kraljic (1983), purchasing has needed to change from an operating function a strategic one. In effect Kraljic (1983) is saying that purchasing and supply management must become less reactive and more proactive. This is a very important point of note for purchasing practitioners and researchers, and is even more striking because this view was in a way the accepted view of purchasing up until at least the late 90s. Kraljic (1983) also

points out that purchasing has an important role to play with regard to environmental issues which is not only visionary with regard to purchasing research but also for businesses in general.

What Kraljic (1983) very astutely recognises in this paper is that global sourcing was to become a key opportunity and risk for manufacturers and organisations in general in the years that followed. In today's lingua franca, globalisation and associated terms are used without a great deal of concern or attention, it is a norm in every respect, which contrast sharply against the situation of the early 80s and again demonstrates just how seminal a paper Kraljic (1983) has become.

The Japanese approach to cost reduction (the Toyota Production System and other lean principles) appeared well before this paper; however Kraljic (1983) makes special reference to them and their potential. One can discern from this that at least amongst the purchasing community in the West, the idea that the purchasing and supply departments would contribute to this trend is, if not completely alien, at least unresolved.

Kraljic (1983) points the way towards a future where data and its successful analysis would become a central factor in purchasing and supply management execution. Although the specific technologies discussed have altered the underlying trend is clear even today.

It is evident in reading Kraljic (1983) that many of the issues of the early 80s have persisted into the present day. People, costs, suppliers, and skills all need to be managed and improved relentlessly. The means of these improvements has obviously developed greatly in the thirty years since this paper. There is a tension apparent in the strategies outlined in the paper which is still present in more recent works. This decision of where purchasing should fit into the wider organisational structure can have a drastic impact on the kind of purchasing which takes place and is therefore central. It is clear that at least as far back as Kraljic (1983) this tension was recognised and accepted as critical.

Summary

Although separated by some seventy five years both the Job and Kraljic share two key similarities. On the one hand, each of the papers shows how consistent and urgent effective purchasing and supply has been, and yet it is clear that the authors felt this is little understood outside of the immediate audience of their journals. This position has now changed and the field has developed into the progressive and significant force which both Job and Kraljic argued for.

3.4 Core Topics for Purchasing and Supply Functions

This section presents the core topics which together have been found in the literature to be of greatest influence on determining the success or failure of a purchasing and supply function.

There is a great deal of literature discussing purchasing and related practices. The approach to solving purchasing problems and enhancing the body of knowledge vary widely. In order to be able to tackle this in a meaningful way, a selection of the pertinent papers were collected and classified in to appropriate categories.

The classification was made by a using a roundtrip process of selection, identification, initial survey, deeper review, and classification. Keywords were analysed and grouped to help with initial identification of papers, along with a review of the abstract of each paper. From there, the body of the papers along with any discussion and conclusions sections were used to identify the main purpose and main thematic placement of the work.

In all, a hundred and twenty nine papers were classified in this way. Doing this enabled the author to identify areas of study that were popular amongst the research community. This then drove the learning process and enabled the author to navigate through the body of literature in a structured way.

Table 3-2. Thematic classification of papers reviewed

Topic	CSR	Sourcing	Inventory
# papers	55	49	25

Each section sets out a focussed review of the topics of Corporate Social Responsibility, Sourcing, and Inventory respectively.

Corporate Social Responsibility

Corporate social responsibility (CSR) relates to an organisation's behaviour towards the people it interacts with and the environment in which it operates (Andersen and Skjoett-Larsen, 2009; Perrini, 2005; Fukukawa and Teramoto, 2009). However, a consensus has yet to be reached on which practices should be regarded as socially responsible (Andersen and Skjoett-Larsen, 2009; Weber, 2008). This can be largely explained by the varying nature of the organisations which CSR is applicable to. An action in one context may be regarded as responsible, but irresponsible in

another. CSR can be considered to be the relationship between an organisation and wider society (Andersen and Skjoett-Larsen, 2009; Boyd et al., 2007; Perrini, 2005) as well as its internal mechanisms. In essence this extends the measure of organisational performance beyond financial and legal concerns into social and ethical considerations including community involvement, diversity, health and safety, workers rights, and the environment (Maloni and Brown, 2006; Perrini, 2005). This means that an organisation can be held to account (through various means up to and including regulatory intervention) by customers, employees and unions, governments, community groups, NGOs, investors, suppliers, regulators, and the media (Maloni and Brown, 2006).

Why it is important

Studies such as this one are increasingly important because shareholders and government agencies are taking interest in the social aspects of businesses. In today's global competitive climate, social responsibility stretches across borders and encompasses not just the immediate operations of the business but also its extended supply chain and how that impacts on the environment and the community. Manufacturers are being asked by their customers to comply with and promote socially responsible business practices.

Opportunities and threats

Purchasing has developed from a functional exercise into a strategically important operation which builds long-term supplier relationships. While this development has led to many positive outcomes for large organisations, it also exposes them to risks from their supply base in terms of non-compliance with expected norms and principles. Large organisations are now considered to be at least partially responsible for the conduct of their suppliers as well as their own (Andersen and Skjoett-Larsen, 2009; Boyd et al., 2007). Successful supply chain CSR relies heavily on the extent to which an organisation's policies have been integrated into its functions and process (Andersen and Skjoett-Larsen, 2009).

Manufacturers are under intense pressure from governments, lobbyists and end consumers of their products to demonstrate socially responsible supply chain practices (Amaeshi et al., 2008). The sourcing practices of large automotive organisations such as the sponsor company are under increasing scrutiny as they are a perceived weak point (Amaeshi et al., 2008). The consequences for any organisation found to be operating in an irresponsible manner go beyond immediate legal concerns and can go on to negatively impact on the brand and public perception (Amaeshi et al., 2008; Boyd et al., 2007; Maloni and Brown, 2006).

Weber (2009) identifies five specific ways in which CSR competency can be beneficial for an organisation:

1. Positive effects on company image and reputation
2. Positive effects on employee motivation, retention, and recruitment
3. Cost savings(substitution costs)
4. Revenue increases (new product development)
5. CSR-related risk reduction

These opportunities require proactive management and decision making. For those organisations that can embrace and manage this most effectively, there is the opportunity to capitalise on their CSR competencies to create a competitive advantage (Salam, 2009). This is due to the fact that CSR competencies are both imperfectly imitable and non-substitutable (Perrini, 2005).

Sourcing

Kraljic's purchasing portfolio model illustrates the use of different purchasing strategies dependent upon where a purchasing department is placed in the model.

It was found by Caniels and Gelderman (2005) that purchasers tend to prefer a scenario where they can maintain their leverage. Selecting the right suppliers to work with is a vital component of achieving competitive advantage; however the ambiguity over what constitutes a fair and reasonable measure makes the process complicated (Amid et al., 2006). Ruiz-Torres and Mahmoodi (2007) found that under experimental conditions the optimal approach to making cost savings with highly reliable suppliers was to single source inputs. Taking this as the optimum quality of supplier, should the quality of supply base deteriorates then multi-sourcing becomes more effective (Ruiz-Torres and Mahmoodi, 2007). Even under such conditions, it does not become economically prudent to extend the supply base further until the reliability of each supplier is considered extremely low and losses are beginning to accrue (Ruiz-Torres and Mahmoodi, 2007). Kauffman and Popkowski Leszczyc (2005) state that the majority of companies know of suppliers that offer inputs at a rate lower than that being currently paid or better quality than that being currently received. As Schiele (2006) points out, a buyer may wish to become the preferred customer of the most valuable suppliers. When considering the value of the supply base, it is useful to distinguish between the strategically relevant and the replaceable. Where a business does not have a competent pool of suppliers, it may miss the benefits of continuous innovation; it will therefore need to invest to create such a pool of suppliers (Schiele, 2006). However, trying to prioritise suppliers by weighting the relevance of each performance measure

is very difficult (Talluri and Narasimhan, 2004) and therefore efforts may be better spent elsewhere.

“The optimal number of suppliers for a buyer to consider should be analytically evaluated rather than be determined by some historical rule of thumb” (Kauffman and Popkowski Leszczyc, 2005). De Boer et al. (2001) reason that any one method of supplier selection is not applicable across all contexts. They identified the following generic characteristics that will assist in assessing supplier performance:

- The number of suppliers available to purchase the inputs from.
- The availability of historic information on past transactions with the supplier
- The importance of the purchase to key business processes.

Inventory

Automotive manufacturers can achieve improved inventory control, reduced operational costs, enhanced productivity, and increased cost accounting accuracy by successfully reducing and maintaining low MRO inventory (Bailey et al., 2007; ; Kane and Baptiste, 2011; Lin, 2011). It has been known for many years that as the technological sophistication of production machines improve the pressure to carry safety stocks increases (Gilbert and Finch, 1985) and that to tackle this suppliers should be closely involved in inventory reduction initiatives (Cohen and Lee, 1990). Spares control is becoming ever more critical, and a lack of needed spares would likely cause unexpected downtimes and financial losses (Bailey et al., 2007). MRO parts often account for 5 to 10% of a manufacturers investment base (Mehrotra et al., 2001), have erratic demand patterns and are rarely used (up to 40% MRO inventories remain unused in any 2 year period (Strijbosch et al., 2000)). In addition, parts are often only available on long lead times (Bailey et al., 2007). There is therefore a strong temptation on the part of maintenance managers to hold large safety stocks. These stock holdings tie-up both financial and physical resources and in already difficult economic conditions this is no longer tolerable.

Inventory holding costs are an important consideration in most production planning scenarios (Tunc et al., 2011). There is a trade-off between, inventory holding cost and the cost of ordering, setups, and shortages (Stavrulaki, 2010). The three main components of inventory costs are physical storage space, financial related costs, and the opportunity cost of capital (Raturi and Singhal, 1990). Spare parts inventories are fundamentally different than typical Work-in-Progress (WIP) inventories. WIP stocks are used to maintain production flows or maintain consistent supplies to market. Spare parts inventories are used by maintenance engineers to keep the

production facility operational. In addition, whereas WIP stocks might increase or decrease with changes in production levels or product make-up, spares are unpredictable (Kennedy et al., 2001).

Kennedy et al. (2001) set out seven characteristics of spare parts and their inventories:

1. Maintenance policies influence usage, i.e. should a machine be replaced or repaired (and if so should this be temporary or permanent).
2. The level and effectiveness of machine monitoring. Where, monitoring is robust lower inventory levels are required.
3. Dependencies in machine and production design. Failure in one area may have an immediate effect on another, e.g. cooling equipment failures can result in damage to temperature sensitive machines.
4. Ability to cannibalise from other machines. Is there is a level of compatibility between machines in different locations, and/or machines designated to be scrapped.
5. Costs can be incurred through quality reduction to the final product, i.e. paint damage to a vehicle from a belt breakage.
6. Obsolescence of the machine. Parts become more difficult and/or more expensive to source.
7. Storage of units of equipment or component parts, e.g. where possible it is cheaper to store individual electrical circuits (which may be of use elsewhere) than complete control units.

The factors outlined above describe some of the main reasons that machine spares inventories can grow out of control. It is not uncommon in the automotive industry for cyclical scraping schemes to be run where facilities personnel remove large quantities of spares stock in largely uncontrolled programmes, simply to reduce the burden of carrying excess stock. Large suppliers, with technically proficient engineers, are uniquely placed to contribute to an effective means of reducing these inventories. What purchasing and supply chain specialists require is a formal means of assessing which of their key suppliers they should partner with to do this work.

3.5 Major Themes

This section discusses many of the most key themes in purchasing and supply literature which have particular relevance to the research programme presented in this thesis. These subsections were drafted through a process of roundtrip engineering. Firstly, the author began by surveying the literature base indexed in major online repositories and collecting keywords and topics using an organic process of trial and improvement. Secondly, papers suggested by colleagues were

added to an early practice review which was presented to the academic supervisor and internal assessment panel. Comments and feedback were taken from this process and over a period of several weeks the main cut of the literature base was made by grouping the most referenced and most interesting papers found into common themes. This process was supplemented by referring to similar reviews in non-related areas.

Strategic Sourcing

The costs associated with the acquisition of inputs, including raw materials, components, and services accounts for a significant proportion of expenditure on production for manufacturers (Gao et al., 2003). Buyers often seek to lower costs by committing themselves to long-term contacts with key suppliers (Serel et al., 2001). Caniels and Gelderman (2005) found that the perceived balance of power between buyer and supplier correlates to the supply risk in the mind of the buyer. Further to this, it is suggested that a balanced relationship does not automatically follow a high level of involvement by both parties.

Suppliers that have secured business can negate the immediate need to find further business and in doing so avoid the additional costs that involves (Serel et al., 2001). It is also suggested that under certain conditions further savings can be made by the supplier where there exists a learning-cost trade-off (Knoppen et al., 2010). Repeat orders are an example of this where once the processes have been established they can be repeated at a near zero marginal cost. It is argued by Serel et al. (2001) that these savings may be passed on to the buyer; however this is far from guaranteed. The supplier is unlikely to want to pass on all these savings; they are after all in the business of making a profit. Either way, if the buyer is fully aware of all these factors the business is more able to negotiate against these savings. Other areas of learning in the buyer-supplier relationship may result in a stabilisation in the quality of inputs received as the two parties cooperate (Serel et al., 2001; Ghijsen et al., 2010).

Scenarios corresponding to the purchasing strategies (Caniels and Gelderman, 2005):

- Strategic - Maintain a strategic partnership, Accept a locked-in partnership, Terminate a Partnership / find a new supplier
- Bottleneck - Accept dependence / reduce the negative consequences, Reduce dependence and risk/find other solutions
- Leverage - Exploit buying power, Develop a strategic partnership
- Non-critical - Pooling of requirements, Individual ordering

It may be the case that large suppliers that have business dealings with world-class purchasing departments can bring new techniques and knowledge to the relationship (Gadde and Jellbo, 2002). The opportunity then arises for using the supplier as an extension of the business function (Gadde and Jellbo, 2002). These arrangements may be very effective although they by no means are certain. One of the consequences of outsourcing might be the loss of competence in the area of concern (Gadde and Jellbo, 2002). This becomes important when considering cost reduction opportunities in the purchasing function. There is a clear temptation on the part of purchasers to push as much of the work up stream to the supplier. Purchasing managers can counteract negative outcomes by maintaining close involvement in any processes they outsource (Gadde and Jellbo, 2002). In some circumstances, the outsourcing of purchasing process to suppliers can bring in additional expertise. Conversely, in-sourcing may prove to be the more productive option to promote innovation. Areas of the business equipped to take on particular purchasing processes (e.g. areas of the wider supply-chain team) are already up to speed with the expectations of the business; indeed some of them may have previous experience in the area.

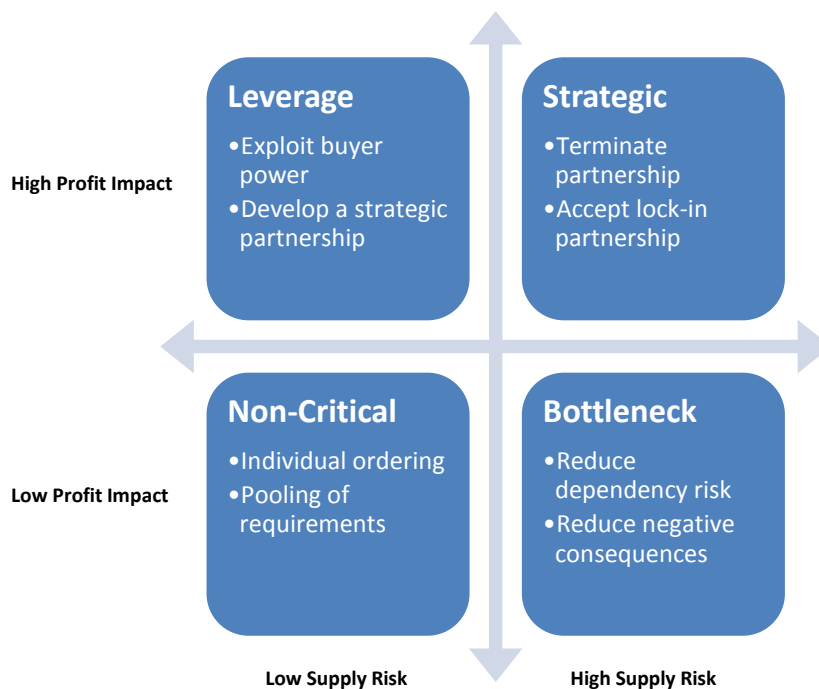


Figure 3-3. Purchasing Strategies for Portfolio Quadrants reproduced from Caniels and Gelderman (2005)

Purchasers tend to prefer a scenario where they can maintain their leverage, but where both the buyer and supplier have a mutual dependence the scene may be set for partnership (Caniels and Gelderman, 2005). The purchasing portfolio model (Figure 3-3) illustrates the use of different purchasing strategies dependent upon where a purchasing department is placed in the model. This approach tends to argue one strategy for each of the quadrants. However, Caniels and

Gelderman (2005) showed that practitioners can take this further and differentiate between alternatives ways forward within each quadrant (Luo et al., 2009).

A transformation of the last twenty years for purchasing managers have been the establishment of global sourcing as an opportunity and in some cases a necessity. Global sourcing is an inherently difficult mechanism to understand and manage with geographical, linguistic, and legal hurdles to overcome (Chandraprakaikul et al., 2010; Costantino and Pellgrino, 2010). To assist the management team, Nellore et al. (2001) set out four recommendations:

- The functional performance and quality of an input along with the supplier's ability to drive innovation are key measurements for comparing alternative sourcing of complex parts.
- Keep suppliers up to date with developments.
- To reduce costs help suppliers develop their capability to reduce their cost base.
- Purchasers should participate in the exchange of ideas early in the engineering cycle.

Along with the benefits that arise (not least of which are cost reductions), global sourcing may be detrimental to the final product in terms of differentiating it from key competitor products (Nellore et al., 2001). This is easily understandable in the sense that if the business acquires inputs on the open market so can its competitors. Nellore et al. (2001) suggest that such components (which require innovation to be successful; e.g. rapidly changing user requirements) should be brought under lean principles with key suppliers. In these circumstances the total cost of acquisition is likely to be a better measure of cost than the initial price (Nellore et al. 2001). Global cost-based sourcing is best suited to acquisition of the least complex components, with lean supply less crucial for sourcing non-complex parts (Nellore et al. 2001; Costantino and Pellgrino, 2010).

Supplier Selection

Selecting the right suppliers to work with is a vital component of achieving competitive advantage; however the ambiguity over what constitutes a fair and reasonable measure makes the process complicated (Amid et al., 2006). Candidate suppliers for strategic long-term partnerships can be identified more easily by managers when each supplier has been categorised based on performance targets (Talluri and Narasimhan, 2004). Each industry will require different selections of performance measures, but common targets in any scenario will likely include, lead time, cost base, flexibility in process alterations, and engineering expertise.

Ruiz-Torres and Mahmoodi (2007) found that under experimental conditions the optimal approach to making cost savings with highly reliable suppliers was to single source inputs. Taking this as the optimum quantity of supplier, should the quality of the supply base deteriorate then multi-sourcing becomes more effective (Ruiz-Torres and Mahmoodi, 2007). Even under such conditions, it does not become economically prudent to extend the supply base further until the reliability of each supplier falls below the accepted waterline (Ruiz-Torres and Mahmoodi, 2007). Kauffman and Popkowski Leszczyc (2005) state that the majority of companies know of suppliers that offer inputs at a rate lower than that being currently paid or better quality than that being currently received. Transfer costs and the fear of the unknown are issues which work in favour of current suppliers, as well as personal relationships and more issues such as technological or transactional lock-in. Historical rule of thumb may play a major part in a manager's assessment of the optimal number of suppliers but that should not be the case, and instead this decision should be made based upon analytical data-driven evaluation (Kauffman and Popkowski Leszczyc, 2005).

According to Kamann and Bakker (2004), a purchaser's opinion of selection criteria is related to:

- The interpretation of the real world and the previous experience of it.
- Status in the company.
- The 'socially negotiated order' on how things should be done.

When considering the value of the supply base it is useful to distinguish between the strategically relevant and the replaceable. As Schiele (2006) points out, a buyer may wish to become the preferred customer of the most valuable suppliers. Any one method of supplier selection is not applicable across all contexts (De Boer et al., 2001). Where a business does not have a competent pool of suppliers, it may miss the benefits of continuous innovation; it will therefore need to invest to create such a pool of suppliers (Schiele, 2006). However, trying to prioritise suppliers by weighting the relevance of each performance measure is very difficult even for the most capable purchasing teams (Talluri and Narasimhan, 2004).

De Boer et al. (2001) identified the following generic characteristics that will assist in the selection of a suitable means of assessing supplier performance:

- The number of suppliers available to purchase the inputs from.
- The availability of historic information on past transactions with the supplier
- The importance of the purchase to key business processes.

Strategic sourcing is closely related to supplier responsiveness and successful supplier responsiveness generates competitive advantage (Carr and Smetlzer, 1999; Cai et al., 2007).

Those businesses capable of positively influencing their first - and perhaps second - tier suppliers are more able to get secure timely and predictable supplies of inputs. Increasing the ratio of suppliers that the business can be confident in meeting critical supplies is another outcome of strategic purchasing. All of this requires the business to align its strategic sourcing plan with the wider corporate plan and in doing so increase overall performance (Carr and Smetlzer, 1999). This indicates a need for strategic purchasing to be incorporated into supply-chain management. For many purchasers, the process may be irrelevant. For example, it may be the case that corporate policy instructs management to choose suppliers based on criteria such as quality and flexibility but when under budgetary pressure cost would perhaps become more important.

Policy

As firms outsource more activities, the strategic relevance of purchasing is increasing (Mol, 2003), becoming less of an isolated function and more of an intrinsic part of business operation (Cavinato, 1996). The role of strategic purchasing is to meet the requirements of the business in terms of input acquisition by aligning the activities of the purchasing function with business-capable opportunities (Carr and Smetlzer, 1999).

Strategic purchasing is in operation where (Carr and Smetlzer, 1999):

- There exists a formal long-term plan.
- The plan is reviewed at regular intervals and adjusted to fit with the wider corporate strategic plan.
- The plan is detailed and includes all the materials and services the purchasing function will acquire.

The measure of value comes not from any principled view but from what the moment requires, so where purchasing is aligned with the rest of the business, it adds considerable value (Cavinato, 1996). The counter-view is that purchasing often does not play a considerable part in the strategic success of a business and only under peculiar conditions it can offer competitive advantage (Ramsay, 2001). One of the arguments put forward is that purchasing itself is only occasionally regarded as a source of core competence (Ramsay, 2001). Purchasing has been and in some instances still is considered to be an operational function usually lacking the ability to be inventive to create value for the business. The evidence for this is that areas of core competence are associated with rewards (financial and otherwise) and that purchasers rarely share in these to the same degree as other areas of the business. Purchasing has in the past been regarded as a

qualifier to competition and not a source of advantage (Ramsay, 2001). This view has been and continues to be changed both within the business community and in published research.

As purchasing research advances and purchasing in the real world receives greater focus, areas in which purchasing can strategically impact on operations is becoming clearer. Chen et al. (2004) state that the modern purchasing function plays a pivotal role in supply-chain management. They argue that strategic purchasing can create competitive advantage by developing and enhancing relationships with a limited group of important suppliers and communicating at all levels of the supply-chain. It is further stated that strategic purchasing adds directly to the bottom line of the buyer by complementing to the business' wider supply-chain capability. It can be surmised therefore that, businesses that are operating strategic purchasing successfully also operate cooperative relationships with their suppliers (Carr and Smetlzer, 1999). There is a need for buyers and suppliers to move on from adversarial style of relationships towards more cooperative ones, and it is therefore apparent that a cooperative relationship between buyer and supplier is a win for the buying organisation. Whether this benefit is as beneficial to the supplier is less clear (Chen et al., 2004) but in practice this uncertainty has not slowed the push towards this closer cooperation.

Ethical and Environmental Drivers

Socially responsible purchasing is the clear expression of corporate values expressed in the operations and processes of the purchasing departments and professionals (Maignan et al., 2002; Fukukawa and Teramoto, 2009; Lamberti and Lettieri, 2009; Tate et al., 2010). Carter and Jennings (2002) found that socially responsible purchasing has a direct impact on the performance, trust and cooperation of suppliers. Their work suggests a direct positive effect on relationships between the business and its suppliers. These positive effects are felt by both parties. Two of the most frequent barriers to environmentally friendly purchasing are management's belief that it is uneconomical and costly to administrate. Carter et al. (2000) found these misgivings to be misplaced. Under ethical purchasing practices, the supplier can invest in improvements to infrastructure, reaching higher levels of performance and quality at lower costs. The buyer benefits from higher quality products at lower prices.

Maignan et al. (2002) identified the following steps towards proactive socially responsible purchasing:

- Prioritise stakeholder needs and wants. Considerations will include stakeholder influence and power but also which needs can purchasing address.

- Establish which corporate values are applicable to purchasing. Incorporate these values into the purchasing process.
- Estimate the likely benefits and costs that socially responsible purchasing will create for the business.
- Pro actively implement these policies.
- Market these policies to gain maximum benefit.

The opportunity for purchasing to make a positive impact on environmental issues has already begun but for this to be expanded, cooperation between businesses in the supply chain is needed (Zsidisin and Siferd, 2001; Lamberti and Lettieri, 2009). European industry has developed these issues well but can go further (Tate et al., 2010). Individual businesses need to work together to analyse the causal relationships of packaging, logistics, design and disposal. From there a more holistic view of the supply chain can be established.

There are some conflicting issues that purchasing managers need to consider when seeking to apply ethical factors into their purchasing decisions. For example, where purchasing secures inputs that are transported in lightweight packaging, the business can benefit from lower packing and transportation costs as each delivery can bring more products. The note of caution here is that such packaging can also lead to higher damage rates. Purchasing management therefore needs to find a balance between the two (Carter et al. 2000). At its best, purchasing can liaise between engineering, manufacturing, logistics and suppliers to develop a cost effective environmentally positive approach.

More than ever before, purchasing managers are integrating environmental and social issues into their purchasing decisions. This is partly driven by trends but also by the bottom line that can show in some circumstances financial benefit. For this trend to continue and develop further, more definite financial benefits need to be shown. There remains a resistance to embracing these values because in many organisations the final measure of a purchaser's performance is solely financial. Fair and meaningful ways of assessing social performance and contribution need to be developed for both internal and external assessments (Tate et al., 2010).

Relationship Management

Manufacturers can reduce their costs and improve quality by entering into closer relationships with key suppliers (Goffin et al., 2006). For the suppliers, securing and maintaining their business relationships is critical to success, and so both parties are finding new ways to cooperate, integrate, or otherwise rework previously pure transactional interactions. Increasingly,

performance factors such as flexibility, punctual deliveries, quality and price are seen as order qualifiers, not key differentiators (Goffin et al., 2006). Indeed in many situations a supplier's core product alone provides little in the way of value creation (Eggert et al., 2006). Purchasers who are looking for new ways to add value to their organisation are much more demanding of their supplier base than they have ever been which means that the pressure on suppliers to include these facets as part of their offerings has never been greater. Relationships between the buyer and supplier are therefore central to modern purchasing and supply management.

Leek et al. (2004) identified three methods of managing buyer-supplier relationships, they are; formal documented systems, personal judgement, and structured meetings. They then compared the perceived usefulness of these methods. In service industries it was found that all three methods were commonly used. Whereas in the manufacturing sector, personal judgement and meetings were far more common (Leek et al., 2004). Across the board formal documented systems were seen as least useful and meetings the most. One of the reasons put forward by Leek et al. (2004) for the differences in approach between the manufacturing and service sectors is the nature of the product they are dealing with. It is argued that because by its nature the manufacturing sector deals with physical products more objective information can be shared. Therefore, relationships get less emphasis placed upon them particularly where the needs of the buyer could be met by a number of suppliers (Leek et al., 2004). Leek et al. (2004) suggest that the changing pressures on the supply-chain require a high degree of competence in relationship management and that this situation will develop further over the coming years.

Close relationships are not appropriate for every relationship but it is through the softer areas, such as joint innovation and information sharing and project partnerships that suppliers can gain advantage (Goffin et al., 2006). From the buyers perspective the supply base should consist of a portfolio of relationship types based on supplier capabilities (Goffin et al., 2006). Before investing in a partnership the buyer should first engage with the supplier to understand precisely where the supplier has useful competencies (Goffin et al., 2006).

Managing a relationship with the intention of improving a supplier's flexibility correlates with reduced acquisition costs for the buyer (Janda et al., 2002). Over the long-term a relationship characterised by cooperative behaviour will result in efficiency and quality gains for the buyer (Janda et al., 2002), although buyer-supplier relationships often carry considerable governance costs (Buvik, 2002).

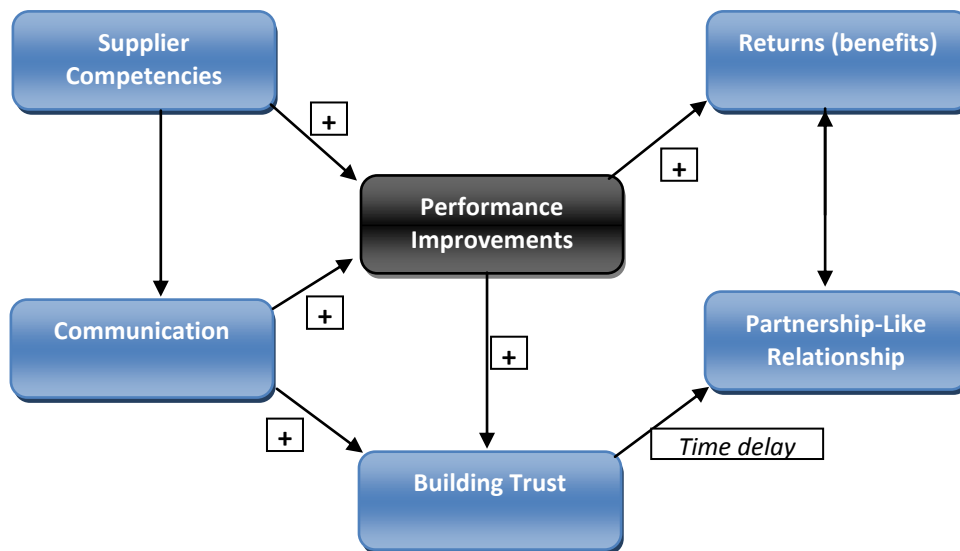


Figure 3-4. Model of supplier relationships reproduced from Goffin et al. (2006)

For the supplier's part, transparency in business dealings deliver value to the buyer, increases their satisfaction, and supports favourable behavioural intentions (Wu and Shen, 2006). The implication for the supplier is that open and clear dealings will help deliver competitive advantage (in the short-term); this is somewhat at odds with the stereotypical approach to deal making. Purchasers respond to transparency by increasing their propensity to re-buy, which is positive for both the supplier and the buyer (the buyer can make savings by removing the need to search for alternative inputs) (Wu and Shen, 2006). Open information exchange needs to flow in both directions for the benefits to be felt (Wu and Shen, 2006; Goffin et al., 2006; Figure 3-4).

To further enhance relationships with purchasing management, suppliers can offer supporting materials, for example tutorials to identify unfamiliar products, decision support tools to assist in the creation of purchasing proposals, and order tracking to monitor the flow of goods (Tellefsen, 2002; Mueller Jr., 2010). These measures could improve purchasing efficiency by increasing meaningful information flow and automating administrative tasks (Tellefsen, 2002). Suppliers can take the lead in developing relationships with buyers by encouraging contact between similar level management in each business (Tellefsen, 2002; Mueller Jr., 2010). Factory tours, face-to-face meetings and less adversarial approach to negotiation could also cultivate more productive relationships (Tellefsen, 2002). In industries where the manufacturer requires suppliers to provide design advice in the early stages of technical development there is a positive link between the relationship and purchasing performance (Wen-Li et al., 2003). In such industries

cooperative transfer of knowledge and expertise are critical and therefore purchasing supply management plays a key role in sustaining the business.

Wen-Li et al. (2003) argue that the most important predictor of purchasing performance is the supplier's strategic objective. Where the strategies of the two firms closely align (e.g. a commitment to continuous improvement) their mutual success is more likely. To develop a supplier requires a great commitment of resources and buyers should therefore select the few that are most likely to succeed (Wen-Li et al., 2003). Carr and Pearson (1999) found that strategically managed long-term relationships with key suppliers positively impacts on the bottom-line. Kamann et al. (2006) did not find overly strong links between the length of a business relationship and supplier performance. Interestingly, they found that expected future business is the greater affect on performance. It was noted that at the inter-personal level expected future business encourages better performance. The implication of this is that purchasing management can positively impact supplier performance by focussing attention of the personal drive of the counterparts in the supplier company. In this way, it is suggested that quality and efficiency might rise.

Economic dependence can be created if there is investment in specific infrastructure and in that way both parties may open themselves up to opportunistic behaviour (Buvik, 2002). Rationalising the supplier base is inherently risky as the business may over time become dependent on a small number or relatively powerful suppliers (Buvik, 2002). Suppliers can induce more profitable purchasing behaviours from buyers by encouraging a buyer-supplier relationship (Bonner and Calantone, 2005). Buyers respond to relationship marketing activities of certain suppliers and by encouraging the buyer to be attentive to the relationship the benefits outweigh those gained through dependence or length of transactional business dealings (Bonner and Calantone, 2005). Buyers successfully managed in this way are more likely to purchase high and steady rates of inputs. Bonner and Calantone (2005) also found that some buyers will implement transaction handling systems that help reduce the suppliers selling costs, and only when attentive relationships are created will the buyer engage in profitable business for the supplier.

In many competitive markets other providers are able to closely mimic the offerings of one another meaning suppliers are seeking to differentiate themselves based on their relationship management practices. Two of the ways they can do this is through personal interaction and knowledge dissemination (Eggert et al., 2006), which help lock-in trading partners. Investments in inter-firm infrastructure incur high levels of dependence and switching costs the main trade-off is logistical efficiency (Buvik and Halskau, 2001). Investments in technology to interface with key

suppliers might further exacerbate this problem for the buyer, as a termination of contract might result in a loss of productive capability (Buvik, 2002). It is therefore suggested that if purchasing management decides to embark on such a strategy it must have a clear and overwhelming economic payoff (higher earnings and/or lower costs) that meets the risk. As the length of the relationship increases the buyer control tends to relax as inter-firm co-ordination develops (Buvik and Halskau, 2001), and a supplier's value with regard to the sourcing process becomes less significant as time passes (Eggert et al., 2006). This is understandable as one can imagine the buyer requiring support services more frequently in the early stages. Operationally this trend is the reverse. As time passes, the buyer is better placed to understand how the supplier's competencies (know-how and time to market) can be exploited (Eggert et al., 2006), meaning that there is a delicate and potentially hazardous balance to be reached between greater interaction, coordination and cooperation, and maintaining independence and flexibility.

Quality Management

As supply chains become more important to business strategy the need for quality assurance to be well handled by suppliers is of greater interest. Securing supplies of materials and components is a key aspect of total quality management (Gonzalez-Benito et al., 2003). With purchasing issues becoming a cross-functional concern it is now important that the business as a whole commits to the principles of quality assurance (Gonzalez-Benito et al., 2003). This reiterates the need for purchasing and supply management to establish itself at the heart of business strategy reviews and policy formulating committees. The positive for senior managers and directors is clear, in that greater levels of business performance can be achieved through the adoption of a programme of strategic supplier activities (Stanley and Wisner, 2002).

This emphasis on quality assurance does not end when the supplies reach the factory gate, but continues throughout the internal supply chain. In order to build greater levels of internal service quality, the effectiveness of internal communication systems needs to be developed (Stanley and Wisner, 2002). It is no longer acceptable to in any way limit effective communication, particularly in the area of resource acquisition. Business-wide activities should be promoted to help improve internal service quality (Stanley and Wisner, 2002), thereby improving the business' ability to draw upon the experience and expertise of individuals across the business who can positively impact on sourcing activities. Suppliers also have a crucial role to play in this, in fact the degree of emphasis a supplier places on process management and employee satisfaction appears to be correlated with the relative success of that supplier (Park et al., 2001). It therefore makes sense

that proactive purchasing managers should seek to ensure that these traits are exemplified not only within their own organisation, but are also mirrored in the operations of their key suppliers.

Gonzalez-Benito et al. (2003) identified five variables that relate to supplier quality assurance practice:

- technological complexity
- product criticality
- purchase value
- company internationalisation
- supplier specialisation

It is common for purchasing managers to equate quality assurance practice with increased costs (Gonzalez-Benito et al., 2003); this assumption however is based upon notion that such activities require substantial investment of people, equipment, and financial resources. This view also does not take into account that the net impact to the business in financial and non-financial terms may prove to be positive, through lower costs and reduced risks.

Quality management also extends beyond the product and process, and in to the workplace as an area of operation. The quality of the workplace is as significant to success as the final product (Stanley and Wisner, 2002). A key concern for practitioners in the purchasing domain is the manner in which senior people treat those under their management. The results of the study conducted by Park et al. (2001) suggest that the way the people in a business function are treated by their management and counterparts has an influence on business performance; this influence could be either a positive or negative one. Crucial to this is the social environment, a spirit of valuing the internal relationships as important to business performance (Stanley and Wisner, 2002). Stanley and Wisner (2002) state that for the business to fully benefit from total quality management initiatives they must commit to improving the quality of the internal workplace.

The extent to which a business is internationalised can indicate its use of quality principles, with larger multi-national firms tending to rely more on these practices than smaller domestic firms (Gonzalez-Benito et al., 2003). On the supplier side it is suggested by Gonzalez-Benito et al. (2003) that larger suppliers are much more selective with the manufacturers they do business with as they have greater independence and/or negotiating power. Although supplier size is not a direct indication of the propensity to implement quality assurance practices, where the buyer has negotiating power over the supplier they supplier is more likely to collaborate with quality initiatives (Gonzalez-Benito et al., 2003). For the buyer, the incentives for insisting that the

supplier adheres to common quality practices are clearer where the costs incurred due the receipt of nonconforming supplies out way the cost of negotiation. It should be noted that the work of Gonzalez-Benito et al. (2003) was carried out in a single industry over a short period of time and therefore definitive generalisations on these issues would require further work.

Lean Principles

Just-in-time (JIT) purchasing is an approach to improve the operation of the purchasing function based on lean principles (Gunasekaran, 1999). At its best, JIT purchasing integrates the purchasing function with other functional areas including; design, production, marketing, distribution and accounting (Gunasekaran, 1999). Where this occurs, this approach strengthens both purchasing position within an organisation and the positive impact that it can have. The implementation of JIT purchasing is usually driven by the buyer in an attempt to reduce costs by holding less stock which tends to increase activity levels in the supplier's distribution centres (Hoffman, 2000). A possible reason for this is then tenancy of inventory is pushed up the chain to the suppliers (Dong et al., 2001). If however the supplier incorporates JIT principles throughout its organisation then it can benefit from JIT purchasing, particularly in areas such as logistical costs (Dong et al., 2001). These findings have direct implications for the long-term survival of the supply-chain; if all involved are not equipped (financially, technically and organisationally) to implement JIT the stability of sourcing may be compromised (Dong et al., 2001).

The focus on quality measures at the buyers end forces the supplier to introduce quality control principles into their distribution centres if they want to maintain their business at the risk of increasing the suppliers costs, and not that of the buyers' (Hoffman, 2000; Dong et al., 2001). Despite being initially seen as an increase in costs it may prove to be a more efficient use of the distribution resources over the medium-term. Just-in-Time (JIT) purchasing offers possible cost savings for both parties but may initially increase costs (transaction and production) if operational implementations between the parties are not well aligned (Gonzales-Benito et al., 2000; Mefford, 2010). As the business implements complimentary practices, the benefits of managing the supply-chain in this way increase (Gonzales-Benito et al., 2000).

De Toni and Nassimbeni (2000) showed that manufacturers performed better when making full use of JIT purchasing. There are three factors that are important to JIT interactions in the buyer-supplier relationship:

- Quality link – formal documented tools for monitoring suppliers.
- Logistical link – organisational integration.

- Design link – assistance and training.

Organisational Structure and Evaluation

The role of purchasing within an organisation is changing; it is now more cross-functional drawing on and adding to resources from across the business, and is critical in implementing management corporate strategy due to its multi-disciplinary nature. However, this transition is not yet complete. Humphreys et al. (2000) argue that for purchasing to be more widely seen as a strategically important function the quality of the people recruited to the position needs to be improved. The academic capability and variation/flexibility of roles needs to be improved (Humphreys et al., 2000). Traditionally, many purchasers have lacked degree level qualifications although this is beginning to change (Humphreys et al., 2000). To fully get to grips with the full issues of purchasing, graduate and post graduate level qualifications are more sought after, which means that the recruitment strategy needs to be re-evaluated to ensure that the business is attracting and developing people sufficiently skilled to undertake the task (Humphreys et al., 2000). Those organisations that are able to offer their staff in-work training to develop their personal and managerial skills will be best placed to reap the benefits that the purchasing function can bring (Humphreys et al., 2000). Leadership in decision making and team oriented assignments are critical to the success of a purchasing department (Pearson, 1996). Purchasing teams play a pivotal role over company's competitiveness, however where the structure of the purchasing function becomes decentralised the strategic role of purchasing may decline (Johnson et al., 2002)

Beyond the abilities of the personnel is the issue of the department itself. Measuring a purchasing department's performance is inherently difficult; therefore comparing the performance of two or more departments is by definition very difficult (Easton et al., 2002). Measurable criteria and appropriate methodologies to aggregate the criterion into a usable index are at the centre of these difficulties. The consequence of this for management is that productivity and efficiency improvements are not only complicated to measure but it can be hard to define what these improvements would look like (Easton et al., 2002). Easton et al. (2002) set out two ways that a purchasing management feedback system could help:

- Accurately reflect weighting and variance in performance factors.
- To be given more helpful information to guide performance improvements.

Continuous Improvement

Loosely translatable to ‘change for the better’; Kaizen is an approach to productivity improvement. From the Japanese:

改 ‘kai’ meaning ‘change’

善 ‘zen’ meaning ‘good’

In English ‘continuous improvement’ or ‘continual improvement’ are often used to mean the same. The ten basic principles are (Bessant et al., 2000):

- Key routines associated with Kaizen
- Understanding – articulate the Kaizen philosophy
- Involvement – encourage and sustain involvement
- Linking – link Kaizen activities to the company’s strategic goals
- Direction – lead and support sustained Kaizen behaviour
- Alignment – ensure consistency of behaviour
- Sharing – where appropriate, implement Kaizen activities across organisational boundaries
- Kaizen – strategically manage the continual improvements
- Learning -encourage and support learning at all levels

The purchasing function lies at the heart of a modern manufacturing company. Through successful purchasing necessary resources are secured. Kaizen is a Japanese approach with a set of core principles that in concert aim over time to improve traditional manufacturing processes. This section will investigate the applicability of Kaizen and similar techniques to the purchasing function and provide the reader with a depth of understanding of some of the challenges and opportunities facing purchasing departments in the United Kingdom's manufacturing sector.

The Kaizen Way

The philosophy of Kaizen has traditionally been applied to the operational processes of manufacturing physical goods. More recently administrative services such as purchasing have become potential areas of application. Industrial practitioners are beginning to apply the concepts developed by their operational colleagues and adapt them to new circumstances (Alexander and Williams, 2005). Recht and Wilderom (1998) define Kaizen as a “mindset to look for ways to achieve... the lowering of costs and the achievement of greater efficiency”. They add

that Kaizen is a non-radical approach to innovation and requires high levels of perseverance. Central to Kaizen is the high rate of internal incremental change. Toyota built its production system on the back of many thousands of small improvements. Each and every improvement was a contributor to change no matter how small or seemingly insignificant it might have seemed (Mogab and Cole, 2000). This operational excellence has not yet been fully realised in the purchasing function.

The current state of literature has not extensively explored the adaptation of Kaizen from other technical disciplines and their implementation in service processes (Alexander and Williams, 2005). Bessant et al. (2000) add that Kaizen literature does not adequately address the routines of a process. They make the three major criticisms:

- implementation is rarely covered
- when implementation is covered it tends to focus on tools rather than behaviour
- authors tend to argue an all or nothing approach over a learned process

It is therefore difficult to assess Kaizen's contribution to cost reduction activities in a service function such as purchasing. It may be the case that the philosophies developed for manufacturing operations are not well suited to administrative tasks.

The understanding and management of stakeholders are critical to successful Kaizen implementation (Mefford, 2010). Ketelhöh (1994) identifies that for the complex set of activities to be achieved, clear and simple business policies for decision making need to be in place. Every stakeholder must be aware of and appreciate the benefits of Kaizen for the business (Alexander and Williams, 2005). Equally relevant to Kaizen success is that workers are seen to be highly skilled practitioners and experts in their domain (Chana et al., 2005). Purchasing practitioners can clearly be categorised as skilled given the level of knowledge required to fulfil a purchasing cycle.

Kaizen's central thesis is one of unending improvement and key to this is the task of involving everyone in the rethinking of what at first sight appears the obvious and of no significance (Recht and Wilderom, 1998). Purchasing environments can be high pressured environments. A major concern to stakeholders can be the disruption of current processes and necessary investment of time and resources required of Kaizen (Alexander and Williams, 2005). Communicating the benefits of change management programs of the nature of Kaizen is hugely important. At the heart of this communication lies honesty in order to build understanding of the root issue being addressed by the Kaizen process (Alexander and Williams, 2005). Modifying the reward structure may be a necessary outcome of adapting Kaizen to some organisational cultures (Recht and

Wilderom, 1998; Mefford, 2010). Crucial to programme success is that every team member understands and accepts the improvements particularly those improvements relating to working practice. It has been found to be especially useful to consult and inform team members and the wider workforce at every opportunity throughout the Kaizen programme (Chana et al., 2005).

Mogab and Cole (2000) explain that technological information is clarified as each individual views the difficulty of tasks differently. This is also often associated with differences in levels of understanding pertaining to concepts and corporeal facts. Perceptions of the problems and problem domain are unique as each member of the team has his/her own distinct information set. Smoother improvement processes tend to follow a period of discussions where common acceptance of available facts is reached. They highlight three key points:

- Kaizen can multiply and clarify the information available on a technology through increased interaction amongst workers.
- Information secured through a variety of sources can brought to the forum by each individual.
- Formal and informal exchanges of information expand the knowledge of each individual.

Alexander and Williams (2005) state that at its core the philosophy of Kaizen is one of optimism with its central tenant being that over time small incremental improvements will have a positive and otherwise unattainable impact on the business. They also describe a series of tasks and outcomes during and after a Kaizen programme; these are:

- An assessment of the scope of an improvement initiative and forming plans early is crucial.
- Kaizen teams should include an individual of sufficient authority to take implementation decisions.
- Synergies can be realised by bringing together participants from diverse fields.
- Benefits of the improvement programme can be realised sooner if the team has the authority to implement decisions quickly.
- Refinement of a Kaizen initiative is less important than its early implementation. This appears to echo the Pareto principle.
- Given the opportunity, individuals respond positively to the opportunities of Kaizen and support the objectives of the programme.

It may be the opinion of a few that 'reinventing the wheel' is a waste of time and resource. However, as Ketelhöhn (1994) points out it is because previous generations have reinvented the

wheel that we have moved from the cart to the automobile wheel. Surely improvements such as this cannot be overlooked. It might sometimes be the case that resistance to improvement initiatives stems from deep rooted anxiety about the potential loss of status of those individuals who currently enjoy special status in the process (Ketelhöhn 1994). In information driven functions such as purchasing this could prove to be a major stumbling block, highlighting the absolute need for 'buy in' at every level.

According to Davison et al. (2004), a Kaizen programme should be viewed as an opportunity to create new knowledge. However, they continue to note that research has not currently described a suitable mechanism for archiving this new knowledge for future use. Currently, it is claimed, the best one can hope to do is merely implement the findings of the Kaizen process. Is it also their conjecture that improvements to the Kaizen processes are more likely to be effective if they are carried out internally as opposed to externally. For Kaizen both the corporeal and conceptual processes are open for improvement and/or recombination (Mogab and Cole, 2000).

Standardising Procedures

Kaizen aims to provide workers of similar duties with similar information during operation. Just how similar this information needs to be for effective improvements is not as clear. During the manufacturing of physical goods, one can perceive a series of standardisations over time that begin to meet this goal; however service functions such as purchasing are inherently non-standard despite best efforts. Mogab and Cole (2000) claim that chaos could ensue if changes are not met with some form of standardisation. This is understandable given that without such standardisation of information a worker could quickly become out of synch with their co-workers. In this context; it is therefore possible to define standardisation as a set of core information pertaining not only to the product of the procedure but also the technology associated with the procedure (Mogab and Cole, 2000).

Workstations that are relatively close to one another can help standardisation take hold. Firstly, it is argued (Mogab and Cole, 2000) that supervisors and other workers may be more likely to acquire knowledge of a change at one workstation if they are in view of it. Secondly, it is also suggested that informal meetings such as breaks and other free periods may assist take up (Ketelhöhn, 1994; Mogab and Cole, 2000). Hoven et al. (1994) add that almost every company has significant lines informal communication. One can relate this to common administrative roles such as purchasing, in many office environments information dissemination consists of both the formal and informal communications between co-workers. Complex changes may require

dedicated training sessions, although this will of course be accompanied by the cost of such training. On this last point, it should be noted that there is also a cost of not acting upon this improvement i.e. the opportunity cost.

The logical conclusion of this argument on standardisation is that perhaps the rate of improvement creation will slow down due to the extra investment in effort. However businesses should balance this with the potential benefits and consequences of not implementing standards. Persistent and consistent action needs to be supported by as many individuals as is possible, which can at times be a difficult task (Ketelhöhn, 1994).

Continual Improvement as a Strategy

“Outstanding corporations are created by consistently out managing the competition”
Ketelhöhn (1994)

Is it really necessary to expend the effort in making small incremental improvements? Perhaps financial manoeuvring might yield more favourable results. A company's resources consist of both tangible (e.g. plant and machinery) and intangible (e.g. knowledge). Kaizen as a process is to a large extent situated in the intangible and its focus is the elicitation of how the business function organises itself and operates. The fundamental processes can be written down, modelled, analysed and shared but the tacit knowledge of the key stakeholders in a Kaizen programme cannot be. Intangible resources are inherently difficult to imitate and are therefore more likely to create long-term competitive advantage. A rival can make similar investments in machinery and stock but cannot copy the quality of the people involved in the operation. Essentially, competitive advantage is found not in capital stock but in how a business can leverage its knowledge and operational excellence (Bessant et al., 2000; Mogab and Cole, 2000).

Wu and Chen (2006) argue that in the information age a company's key source of competitive advantage is its ability to innovate. At the core of this innovation, they suggest lays the principles of Kaizen. They add that businesses should move past the notion of 'great creation' and instead acknowledge that accepted and in some cases admired concepts of the past may not necessarily hold true today and/or lead to future success. Hoven et al. (1994) supplements this view with a warning to workers that if they are too ambitious and seek to change too much too fast they are unlikely to stay with the company for very long.

“The excellence of an organisation is contained in the common ways by which its members have learned to think, feel and act” (Irani et al., 2004).

They continue to state that management must seek to understand how it can promote a corporate culture that is supportive of learning how to change through participation and teamwork. Furthermore, workers should be empowered for effective quality improvements to be realised. Hoven et al. (1994) share this view and state that success is highly dependent upon employee involvement. Kaizen brings together all levels of management and workers, and in general continuous improvement strategies are most effective where all activities take place in close proximity (Mogab and Cole, 2000). Therefore, it may be useful to locate senior decision makers amongst the implementers of the policies and decisions.

Irani et al. (2004) set out four characteristics that encourage organisational innovation and continuous improvement:

- A free flow of information that allows managers to find ideas in unexpected places and pushes them to combine fragments of information;
- Close and frequent contact between work sections and an emphasis on lateral as well as vertical relationships;
- A tradition of working in teams and sharing credit; and
- Managers who believe in innovation and provide the necessary resources and support.

Bessant et al. (2000) investigated the company 3M and found that although the company had “formal codified knowledge in the form of patents, process designs, etc.” a significant amount of the companies competitive resources were in the form of employee experience and other tacit knowledge. Similarly, it was discovered that many operations had been notated and modelled but that much of behaviour of the individuals and groups operating inside the firm was tacit. As an approach to generating a greater understanding and asking the questions of how things are done and why, Kaizen can be used to limit a company’s exposure to such risks (Bessant et al., 2000).

Should a business function fail to satisfy its customers (this applies equally to internal customers as it does to external ones) it will ultimately face a form of liquidation (Irani et al., 2004). The form that this takes will be in large measure dependent upon the nature of the business function in question.

Table 3-3. Kaizen versus Innovation

	Kaizen	Innovation
Time scale	Long-term	Short-term
Philosophy	Incremental	Radical
Participants	Teams	Individuals
Approach	Continuous Improvements	New Creations
Drivers	Knowledge	Technological Advancement
Investment	Smaller, sustained	Larger, infrequent

There is no conceptual difference between invention and incremental improvement (Mogab and Cole, 2000). The significant difference lies in the scale of change and the consequences that follow (Table 3-3). The interest in routines (behavioural patterns) is increasing, these routines can be utilised to create operational and through that strategic advantage due to higher levels of participation and innovation. Failure and resulting disappointment associated with many Kaizen programmes is largely attributable to deficiencies in the understanding of behaviour and insufficiently developed routines (Bessant et al., 2000).

In an initiative to improve units of production, number of people, square feet of floor space, and work in process inventory at a live manufacturing facility, Trostel and Light (2000) observed “that the gains achieved in the Kaizen events were difficult to sustain” but that “there was some lasting impact of the Kaizen events”.

3.6 Points of Interest and Research Gap

This section sets out some of the most interesting points raised in the process of conducting this review in a more accessible format. It also gives further reflection on what the issues raised in the papers reviewed will mean for the process of further analysis and how this impacts on the rest of the research programme.

- Purchasing and supply management are playing a greater role in ensuring the viability of a business

- The field has grown into a much broader holistic and strategic business function
- Satisfying market demand is determined by a business' ability to manage uncertainty, for which purchasing is uniquely placed.
- All members of the supply chain need to invest and commit extensive resources to deliver sustainable performance improvements
- Stakeholders will increasingly find that mediation between buyers and suppliers is critical to their success
- Greater levels of business performance can be achieved through programmes of strategic supplier evaluation
- To build greater levels of internal service quality, the effectiveness of internal communication systems need to be enhanced
- The degree of emphasis a supplier places on process management is correlated with the relative success of that supplier
- Suppliers can bring new techniques and knowledge to the relationship
- One of the consequences of outsourcing might be the loss of competence in the area of concern; purchasing managers can counteract negative outcomes by maintaining close involvement in any processes they outsource
- Strategic sourcing is closely related to supplier responsiveness and successful supplier responsiveness generates competitive advantage
- Three important methods of managing buyer-supplier relationships are, formal documented systems, personal judgement, and structured meetings
- Transparency delivers value, increases satisfaction, and supports favourable behavioural intentions
- Any new purchasing strategy must have a clear economic payoff (higher earnings and/or lower costs) that meets the risk
- Where the structure of the purchasing function becomes decentralised, the strategic role of purchasing may decline
- Socially responsible purchasing is the clear expression of corporate values
- Perceived barriers to environmentally friendly purchasing are that it is uneconomical and costly to administrate
- Under ethical purchasing practices, the supplier can invest in improvements to infrastructure, reaching higher levels of performance and quality at lower costs; the buyer benefits from higher quality products at lower prices

In giving a close analysis to the literature it has become clear to the author that there is a distinct gap in the research. The field of purchasing and supply management has grown at increasing pace over the last fifteen years and has developed from a collection of disperse topics into a holistic management and operations discipline. However, the rate at which the key topics have been able to integrate into holistic methodology has not been as clear. There remains a dearth of research which proposes to address the integration of sourcing and inventory management, alongside corporate social responsibility, in a fashion which will allow practitioners to meet the challenges they face on a daily basis. There is as yet no methodology which can help practitioners identify, manage, and reduce risks and costs across these three crucial factors in a sustainable way.

3.7 Summary

The role of purchasing within an organisation is changing; it is now more cross-functional drawing on and adding to resources across the business, making it critical in implementing management's corporate strategy. Currently, measuring a purchasing department's performance in a fair and meaningful way is complicated. Identifying measurable criteria and appropriate methodologies to aggregate the criteria into a usable index is at the centre of these difficulties. For management this means that productivity and efficiency improvements are not only complicated to measure but also it can be hard to define what the improvements would look like. These are the areas that future purchasing research needs to address.

The key gap identified through this literature review is that the topics of corporate social responsibility, sourcing, and inventory management have yet to be studied as integrated issues. Although this review has found a number of highly pertinent individual studies, there is a lack of work which successfully brings these topics together into a holistic methodology to reduce costs and risks in a manufacturing context. In addition, the researcher found no methodology which focussed on the practicality of cost reduction in purchasing in a manufacturing context. The sources most referenced in the field focus attention on theoretical argumentation over real world implementation. There is therefore an opportunity for a methodology to be developed which will bring together socially responsible purchasing and inventory management to deliver a comprehensive and practicable toolset.

The review shows that the approaches taken to purchasing management are inter-related in pursuit of a common goal, to make purchasing more relevant and more effective in delivering value to the business. It has also been demonstrated that there remains inconsistencies with approaches and outcomes and that our knowledge of how purchasing might be improved is

incomplete. The most useful studies have almost exclusively involved an element of real-world experimentation or case-study analysis. In addition to purchasing and supply management, the areas of continuous improvement and corporate social responsibility have been identified as areas to investigate further.

Chapter 4

Research Programme

4.1 Introduction

The industrial and academic scope of the research has been set out in Chapters 2 and 3 respectively. The purpose of the research programme is to define a novel approach to achieving cost savings in the purchasing function and processes of large-scale automotive manufacturers. This chapter summarises the research aim and objectives, and methods employed in meeting those objectives.

4.2 Chapter Structure



Figure 4-1. Chapter structure

4.3 Problem Domain

Industrial Perspective

The sponsor company is recognised as being a high-quality automotive manufacturer, and a producer of vehicles at competitive levels of production efficiency. The company has two sites based in the UK and at normal capacity levels produces almost 900 vehicles per day. At full capacity the company is a significant contributor to the local economy, by directly employing up to 5000 workers. In supporting this research programme, senior business managers have signalled their intentions to accelerate cost reduction activities. There is a recognition that their cost base is such that new methods of cost reduction need to be developed in order to sustain the UK divisions over the long-term.

The recent challenging economic period was acutely experienced by the sponsor company. One production line has been mothballed and a process of cost cutting has been implemented. This research is therefore of significant importance to the sponsor and those manufacturers who also find themselves in a period of low demand for their goods.

Planning a successful programme of academic research within the constraints of a live environment has been the key challenge. To satisfy the requirements for the degree of Engineering Doctorate, the programme has needed to be sufficiently robust and objective as to be deserving of the award. In contrast, the programme of research has been undertaken and implemented in a real world environment, with the daily constraints of simplicity and appropriateness that arise from that. And so in developing the research programme, the researcher has been sympathetic to both of these needs. The details of this undertaking are presented in the remainder of this chapter.

Aim and Objectives

The issues (identified in the literature and from investigations of the challenges facing practitioners in the field) have been distilled into a single research aim with supporting objectives. The aim of this research is to:

“Develop a novel methodology for identifying and implementing cost reduction activities for the purchasing function of automotive companies. These activities will implement continuous improvement in the purchasing process, including costing, sourcing, stocking, and social responsibility assessment.”

To realise this aim, the following objectives have been identified and executed:

1. Explore how strategic purchasing is implemented in the field and identify the key issues facing practitioners.
2. Provide a representation technique for the identification of price reduction candidates and the comparison of dissimilar supplier bids.
3. Capture the social responsibility competency of the supply base and provide a formal means of measuring and reporting supplier compliance.
4. Provide a representation technique for the identification of stock reduction candidates and investigate the use of supplier knowledge in stock reduction.
5. Design a skeleton methodology for strategic purchasing that assimilates the results of Objectives 2-4.
6. Validate the research results within the purchasing environment of the industrial collaborator (Objectives 1-4) and through structured interviews (Objective 5).

4.4 Research Methodology

Figure 4-2 shows a conceptual model of the research programme the author developed for the research.

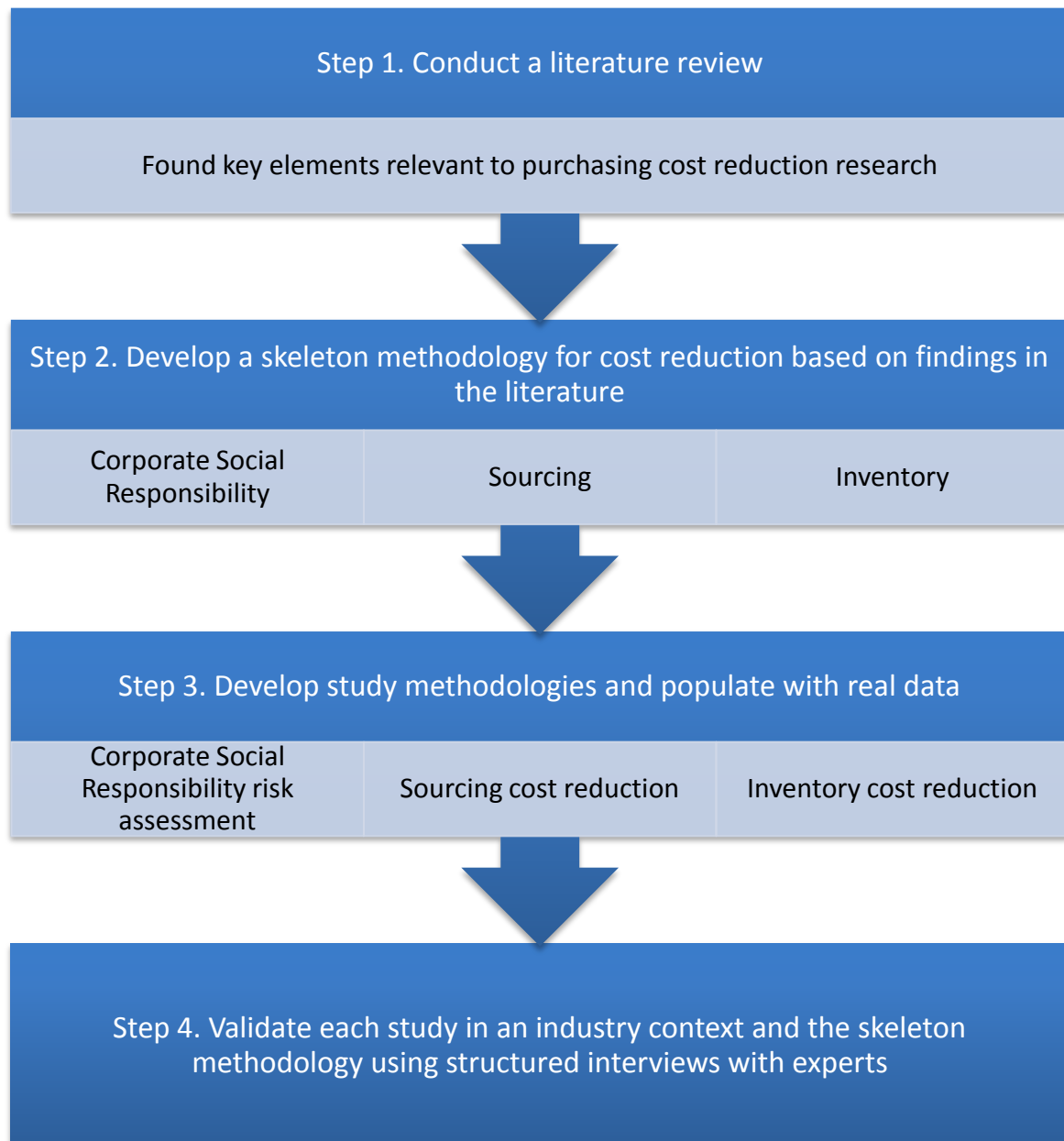


Figure 4-2. Research process flow

Each of the steps shown in the research process flow are described below.

Step 1. Conduct a literature review

The research carried out a literature review of the purchasing and supply management field. This review considered the key themes of purchasing practice and how they inter-relate. Based on this review, the author was able to identify the key issues facing practitioners. Through this

process, the author was also able to identify a gap in the current body of knowledge, namely the scarcity of holistic and practicable methodologies to reduce costs and risks.

The research also carried out an investigation of the management issues impacting the field. Both the macro and micro level environments were considered and analysed. This analysis considered the impact that government level policies have on manufacturing organisation such, as the sponsor company. The year on year trends were found to be largely unfavourable, constituting a challenging economic environment in which purchasing practitioners are operating.

Step 2. Develop a skeleton methodology for cost and risk reduction based on findings in the literature

The research identified three components of purchasing practice and theory which contribute towards cost and risk reduction in the field. The skeleton methodology consisted of an overarching process flow which describes how the inputs and outputs of the three studies connect to form a holistic methodology.

The first major component identified through the literature which presented a likely area for fruitful investigation was that of socially responsible purchasing. Fair and meaningful ways of assessing social performance and contribution were developed for both internal and external assessments. The second major component identified through the literature which presented a likely area for fruitful investigation was that of strategic sourcing. The third and final major component identified through the literature which presented a likely area for fruitful investigation was that of lean inventory management. Inventory reduction was therefore identified as a key component of the PCRRM in order to provide the final piece of the methodology.

To complement and strengthen the findings and issues raised through desk based reviews, the author set out to conduct a series of preliminary field studies. These studies took place using live data from the purchasing and supply databases of the sponsor company. The central database was surveyed using the Hyperion database client.

Using the most significant commodities and most significant suppliers (by spend), their inter-relationships were analysed. Data extraction queries were re-run and the results limited to the relevant subjects. Pivot tables and Pareto analysis were employed to calculate the contribution to total spend on the most significant commodities that each of the suppliers accounted for. Similar analysis from the supplier perspective was run, that is the contribution that each of the most significant commodities made towards the issue value of supplier parts.

Step 3. Develop study methodologies and populate with real data

Corporate Social Responsibility risk assessment

The research carried out a corporate social responsibility (CSR) supplier risk assessment. The process developed included desk based analysis of historical and live purchasing data to assess the extent to which the sponsor company is exposed to each supplier in its supply chain. The technique was able to identify which suppliers should be targeted with CSR competency evaluations and measure the results in an objective and repeatable way:

- Rank suppliers by financial exposure:
 - The first stage in selecting participants for the CSR evaluation was to identify candidate participants that would be put through the pre-evaluation assessment.
 - This meant identifying from the database suppliers which should be assessed by experienced buyers and selected for the full CSR evaluation.
 - Spend data from the previous year was downloaded from the central database. This data was in the form of individual transactions for the purchasing of consumables, machine spares, and services.
 - Pareto analysis on the spend data was carried out to identify the suppliers which together accounted for 80% of total spend in the previous year.
 - Initial list of suppliers was presented to the purchasing manager for scrutiny.
 - Rank suppliers in order of spend.
- Confirm candidate participants:
 - Identified from the suppliers with whom the sponsor company was most financially exposed, and which were also perceived to be the most uncertain in terms of CSR related issues.
 - This was achieved by drawing upon the experience of the purchasing department's buyers to conduct a pre-evaluation assessment of each supplier against criteria set out in the sponsor company's supplier responsibilities documentation.
 - For each question the buyer would give a mark on three-point-scale, which in their judgement, represented the suppliers competence or compliance (mimicking the sponsor company's internal assessment system).
 - Each supplier's total score was used to rank it in order of perceived risk.
- Calculate risk index and select participants:

- The final stage in selecting participants for the CSR evaluation was to combine the two measures of risk into a total score for each supplier.
- The rank from the exposure analysis and the rank from the pre-evaluation assessment were multiplied to give a final score.
- The worst performing suppliers were selected as questionnaire candidates using this figure.
- Questionnaire:
 - The supplier companies were sent a questionnaire to assess their CSR competencies. The questionnaire was administered online with a carbon copy spreadsheet version for those suppliers who were for technical reasons not able to complete the questions online. Positive/desired responses received 1 point with each section having a maximum number of points available. The results of this were then weighted against the relative importance of each category of questions to derive an overall score and identify suppliers for CSR audit.
- Deployment:
 - The questionnaire was sent to suppliers for completion within a predefined timeframe.
- Evaluation:
 - The responses from the participant suppliers were evaluated and scored to identify suppliers to be considered for future CSR audits.

Sourcing cost reduction

The research carried out a study which established a process to calculate the relative merits of supplier bids for machine spares sourced from long lead time locations. It identified the data and analytical support required to establish a fair and effective means of comparing supplier bids that were dissimilar in size or focus.

The first step in the process was to identify a suitable sample of Japanese origin machine spares to compare. These parts would be used to compare prices between the UK and Japan. This was done in two parts: firstly the database was consulted to identify parts with a manufacturer field containing a known Japanese manufacturer; secondly the Purchasing Manager was interviewed to refine and add to this list based on his/her experience. The parts were selected based on their suspected usage in both regions.

The most significant Japan parts, manufacturers and suppliers were identified from the sponsor company database using Pareto analysis. The usage and price were used to calculate the most recent spend over a 12 month period.

This process retrieved machine spare numbers which were suitable to include in the trial. Using this data, the manufacturers of these parts were identified from the database.

The next step was to identify potential suppliers for these parts to be included in the trial. This was carried out in two steps. Firstly, the supplier data on the information system gave the current supplier for each part line by line. Secondly, the Purchasing Manager and buyers in the purchasing function were interviewed to identify historic and/or potential supplier for these parts. Using this author negotiated a consensus between the Purchasing Manager and a Senior Buyer as to which suppliers were to be included. The final count was six large suppliers with European subsidiaries.

Following the initial data retrieval and settlement on which suppliers to involve, the author asked the buyers in the department to contact their equivalents at each supplier and give them an initial presentation of the purpose of the work. The Purchasing Manager also discussed the intentions of the process with her contacts at senior levels within the supplier companies. The suppliers were invited onto the site to be given a formal presentation of the trial and provided with the part data. The suppliers were given one month to return their tenders.

The first step in analysing the supplier tenders was to pull them into a single point of reference. To do this, a template was developed. For each of the suppliers' quotations, any irrelevant information was stripped out from the returned files, leaving only the response (the quoted price), the quoted lead time, the current value, and the new value. With the converted quotations populating the template the results were graphed and tabulated to be analysed at the macro-level.

Inventory cost reduction

The research carried out an assessment of the inventory holding of a large automotive manufacturer. This was conducted using desk based data analysis and identified a partner supplier to coordinate the inventory analysis with. In addition, the study established a process for managing the identification of commodity groups to investigate, and the transfer of parts data and analytical findings between the parties.

To establish a list of potential inventory reduction partners, twelve candidate suppliers were selected from a list of the most significant suppliers by spend with the company, along with suppliers identified through internet search and industry recommendations. After initial contact with each of the candidates the questionnaire was sent. The sections of the questionnaire were based on the supplier competencies identified during the literature review.

- Section 1: COMPANY DETAILS (is the supplier of sufficient scale to undertake this project)
- Section 2: MRO INFORMATION (what if any similar activities are they involved in elsewhere)
- Section 3: COMMODITY INFORMATION (do they have the engineering expertise)
- Section 4: WIDER EXPERTISE (can they bring additional knowledge to the project)
- Section 5: INFORMATION SYSTEMS (how will they interact with the company systems)

Two senior buyers separately assessed the responses and evidence provided by the suppliers against a three point grading scale (2 = Good, 1 = Satisfactory, 0 = Unsatisfactory). The buyers used these responses along with supporting evidence such as online financial data, supplier publications and their experience of business dealings to make their assessment the chosen supplier was invited to trial their services at the sponsor's plant.

Implementation of the trial

The starting point for the implementation of the study was to identify the commodities which the supplier would investigate and deliver their analysis and recommendations. Data base was analysed by inventory levels versus commodity holding. This data was overlaid against the internal matrix of part groups used by the sponsor company and understood to a large extent by the supplier. The process of selection was conducted in a meeting with the supplier, the purchasing team, and the facilities experts. The author developed a framework for managing the exchange of information between the supplier and the three internal parties. The supplier was provided with the data for all five commodity groups at the start of the trial. The agreed timetable of analysis was for the delivery of each set of results at two week periods.

The supplier produced weekly updates of progress against each commodity. The recommendations were returned in the standard template designed by the author. The recommendations were made in one of two categories, to either remove the part from the order purchase cycle through burning off and/or order disposal, or to merge duplication part listings into a single identity on the mainframe system and database.

Production control took the recommendations made by the supplier and sense-checked them before sending the findings and recommendations onto maintenance specialists for assessment and approval.

Step 5. Validate each study in an industry context and the skeleton methodology using structured interviews with experts

The research validated the findings of each case study in the live purchasing environment of the sponsor company. The results of the cases were implemented into the company procedures during the implementation of the research programme. In addition, the research carried out a process of validation at the methodology level using academic and practitioner experts. Both groups of evaluators confirmed the utility of the proposed methodology based upon accepted assessment criteria.

The author designed an evaluation questionnaire which would be presented to two panels of reviewers. The first panel consisted of academics, and the second of industrial practitioners. The validation process was conducted over two days. The evaluators were given the questionnaire and asked to complete and return. To assist the evaluator, a standardised scale for considering each aspect of the PCRRM was offered, with the opportunity to add further comments wherever chosen. The questionnaire was made up of five sections of questions labelled as sections A to E.

- Section A. Feasibility: This section intended to understand the practicability of the proposed methodology and whether or not it would be likely to be viable.
- Section B. Usability: This section intended to understand the likely ease of applying the proposed methodology.
- Section C. Usefulness: This section intended to understand the effectiveness of the proposed methodology and whether or not it would be likely to be convenient in usage.
- Section D. Modification: This section was included to allow the evaluator to identify the component of the PCRRM that they felt was the strongest and the component that they felt was the weakest.
- Section E. Design Features: Considers how valid the proposal is as a methodology in its own right.
- Section F. Any other comments: The questionnaire concluded by giving the evaluators the opportunity to give any comments they may wish to share.

4.5 Summary

This chapter presented the aim of this research programme and discussed the route to achieving this aim. The aim was elaborated on to identify the specific research objectives which will support the investigation of the research problem in order to establish a novel approach managing cost and risk reduction in the purchasing and supply management field. The research methodology was then discussed and each key step in meeting the research objectives was described to give an overview of the methods used.

Chapter 5

Development of the Skeleton Methodology

5.1 Introduction

This chapter presents the development of the skeleton for the Purchasing Cost and Risk Reduction Methodology (PCRRM). The body of this chapter discusses the major influences that both academic and field based research had on the formation of the PCRRM. The final major section presents a conceptual model of the PCRRM to be populated by the studies presented in Chapters 6, 7, and 8.

5.2 Chapter Structure

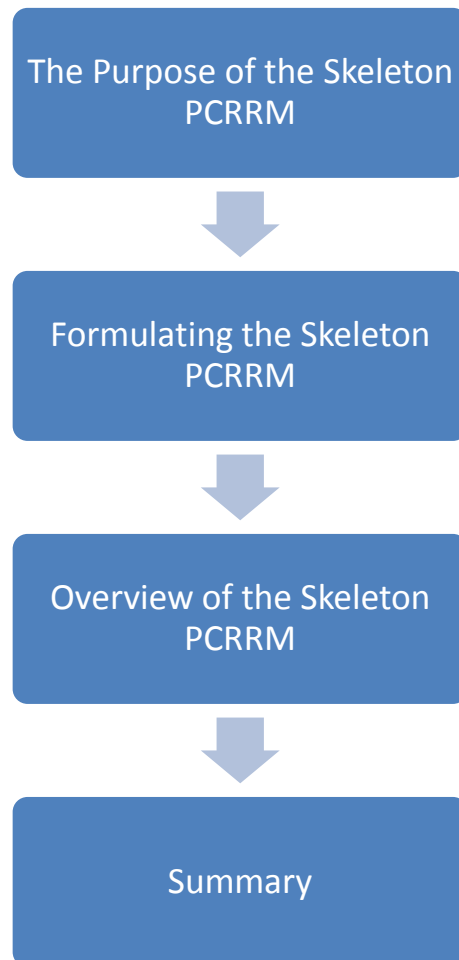


Figure 5-1. Chapter structure

5.3 The Purpose of the Skeleton PCRRM

The development of skeleton methodology is central to meeting the research aim and objectives as described in earlier chapters. The skeleton constitutes the basis of the final contribution by bringing together the three components of the research programme to form the Purchasing Cost and Risk Reduction Methodology (PCRRM). This stage of the research was conducted by both literature and field analysis. The main implication of this work has been the ability to design and implement the three case studies presented in Chapters 6, 7, and 8 in a manner which ensures the results integrate to produce a consistent solution to the research question. The approach developed to complete this work is not specific to the problem situation and may be a useful mechanism in related research areas.

Early research and literature analysis identified the need for a multi-faceted approach to tackling the pressing issues of cost and risk reduction in purchasing and supply management. As has been discussed in previous chapters of this thesis, there are a number of inter-related areas for improvement. These areas of improvement require a coordinated and concerted programme of research if manufacturers such as the sponsor company are going to be able to meet the challenge.

The skeleton therefore provides a basis for designing a broader set of intensive studies than would otherwise be possible. Using a skeleton as a basis for designing the studies presented in chapters 6, 7, and 8 has allowed the author to ensure that the methods and results complement each other to produce a holistic methodology for reducing costs and risks in the purchasing and supply field. Without this level of coordination the methods and/or results of any programme of studies may not be as useful in answering the research question.

Aim and Objectives of this Chapter

The aim of this study was to investigate the formalisation of the skeleton methodology. Specifically the work sought to identify and finalise the key inter-related components of the PCRRM and demonstrate a means through which these components could be best integrated.

The objectives of the work which led to this aim were:

- To refer back to the literature and propose why the key areas related to costs and risks in the purchasing and supply field are candidates for inclusion in the PCRRM.

- To identify through interviews with practitioners and analysis of purchasing data, how costs and risks are inter-related at the conceptual level and identify how these might be practically tackled in a live environment.
- To produce a flowchart showing the main inputs and outputs of each component (corporate social responsibility, sourcing, and inventory) and how these inputs are related across the wider methodology.

5.4 Formulating the Skeleton PCRRM

Key Characteristics

This section sets out some of the characteristics that the PCRRM should have if it is to be useful to practitioners. The skeleton methodology alone cannot provide these all of the features. The individual components of the PCRRM (Figure 5-2) will realise much of this in the low level details of the steps needed to fulfil each of them.

In the early weeks and months of the EngD, unstructured interviews and conversations were held with the purchasing manager and other specialists working in the purchasing department. The author was able to review work plan documentation and other internal materials to understand how similar process management documentation was put together.

The interviewees provided detailed advice on the key characteristics that a methodology such as the PCRRM should possess:

- Target – clear communication of the intended outcome
- Scope – the boundaries and limits of the work
- Structure – a logical layout and flow
- Records – archiving of data and work in progress
- Actors – list of participants and key duties
- Administration – efficient management of available resources
- Tools and techniques – the actions and resources required to complete each stage
- Products – defined inputs and outputs at each stage

Literature

The literature review highlighted the need for a well structured and comprehensive approach to tackling the issues facing purchasing and supply management as it continues to professionalise itself. Purchasing functions are facing substantial challenges, not least of which is to reduce help their organisations to become and remain competitive in an increasingly difficult business

environment. To get there, practitioners in the purchasing and supply field need a set of tools to make effective, repeatable, and efficient impacts on their operations.

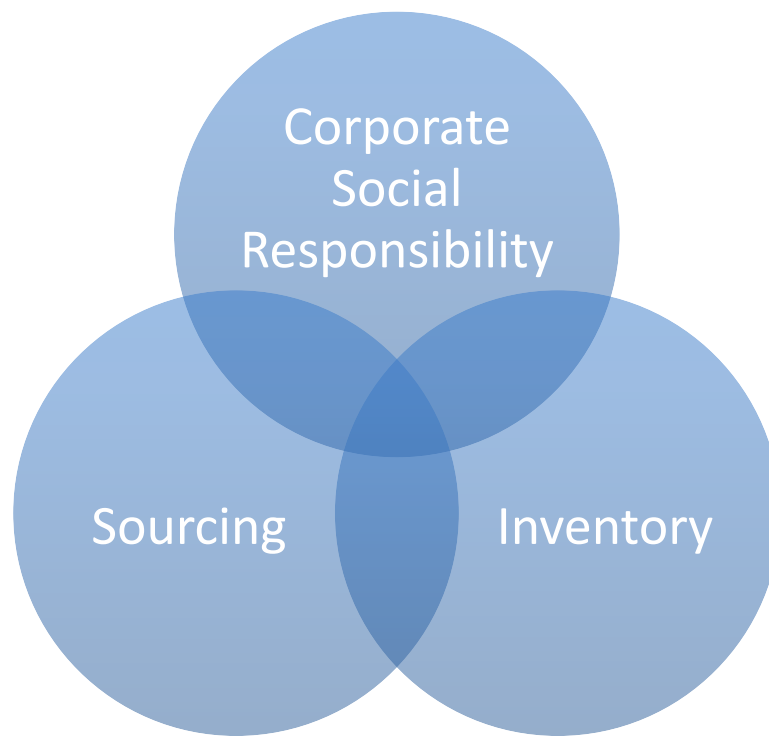


Figure 5-2. The inter-related areas of cost and risk in purchasing and supply

Corporate Social Responsibility as a Component

The first major component identified through the literature which presented a likely area for fruitful investigation was that of socially responsible purchasing. Socially responsible purchasing has a positive impact on the performance, trust and cooperation of the supplier base. The likely impact would be felt by both the sponsor company and the supplier organisations. In conversations with practitioners in the sponsor company, cost and difficulty to implement were frequently cited as reasons for purchasing and supply managers' reluctance to participate in such activities. The literature review has also revealed that there is a dearth of practicable methodologies for implementing corporate social responsibility (CSR) in the purchasing environment, making this area a useful component to be included in the PCRRM. If a methodology could be developed to allow ethical purchasing practices, it would mean that a supplier could invest in improvements to infrastructure, reaching higher levels of performance and quality at lower costs.

The three steps for this component were identified by Maigan et al. (2002) as:

- Prioritise stakeholder needs and wants. Considerations will include stakeholder influence and power and also which needs can purchasing address.
- Establish which corporate values are applicable to purchasing. Incorporate these values into the purchasing process.
- Estimate the likely benefits and costs that socially responsible purchasing will create for the business.

For CSR to be included in the PCRRM, the component will need to overcome some conflicting issues. For example, where the sponsor company secures inputs that are transported in lightweight packaging, they can benefit from lower packing and transportation costs as each delivery can bring more products. However, this might lead to production issues through higher damage rates and therefore the component will need to find a balance between the two. In order for the PCRRM to be accepted into an organisation, the CSR component will need to show definite financial benefits as there remains a resistance to embracing these values because in many organisations the final measure of a purchaser's performance is solely financial. Fair and meaningful ways of assessing social performance and contribution need to be developed for both internal and external assessments.

Strategic Sourcing as a Component

The second major component identified through the literature which presented a likely area for fruitful investigation was that of strategic sourcing. Strategic sourcing is a critical area for purchasing and supply management. When done correctly, the costs associated with the acquisition of inputs can be reduced to a level which will have a significant impact on overall expenditure.

Scenarios corresponding to the purchasing strategies (Caniels and Gelderman, 2005):

- Strategic - maintain a strategic partnership, accept a locked-in partnership, terminate a partnership / find a new supplier
- Bottleneck - accept dependence / reduce the negative consequences, reduce dependence and risk/find other solutions
- Leverage - exploit buying power, develop a strategic partnership
- Non-critical - pooling of requirements, individual ordering

Medium to long term contracts are the need of the day as both buyers and sellers seek to establish a secure business model through difficult competitive times. Supply risk is critically

important for manufacturers, and should strategic sourcing be mishandled, a manufacturer (such as the sponsoring organisation) could suffer financially. There remains no significant work in this area which can practicably implement strategic sourcing at zero cost without unfairly impacting on and/or severely damaging the supply base. For this reason, strategic sourcing should be included in the final methodology as a component of the PCRRM.

Inventory Reduction as a Component

The third and final major component identified through the literature which presented a likely area for fruitful investigation was that of lean inventory management. Just-in-time (JIT) is an approach to improving the operation of the purchasing and supply function based on lean principles. When operating at optimum efficiency, JIT inventory management integrates with the purchasing and supply function. Where this occurs, this approach strengthens both purchasing position within an organisation and the positive impact that it can have. Lean principles are well researched and documented, however implementation in the management of general consumables under a wider purchasing cost and risk reduction programme have not been found in the literature base. Inventory reduction should therefore be a key component of the PCRRM in order to provide the final piece of the methodology.

Field Research – Data Analysis

To complement and strengthen the findings and issues raised through desk based reviews, the author set out to conduct a series of preliminary field studies. These studies took place using live data from the purchasing and supply databases of the sponsor company.

The central database was surveyed using the Hyperion database client. Analysis of the company's data found that there are at least three main approaches open to investigation. It was found that the purchasing data can be analysed from the perspective of commodities, suppliers or manufacturers.

Commodities vs. Suppliers, Suppliers vs. Commodities

Using the most significant commodities and most significant suppliers (by spend), their inter-relationships were analysed. Data extraction queries were re-run and the results limited to the relevant subjects. Pivot tables and Pareto analysis were employed to calculate the contribution to total spend on the most significant commodities that each of the suppliers accounted for. Similar analysis from the supplier perspective was run, that is the contribution that each of the most significant commodities made towards the issue value of supplier parts.

Commodity Analysis

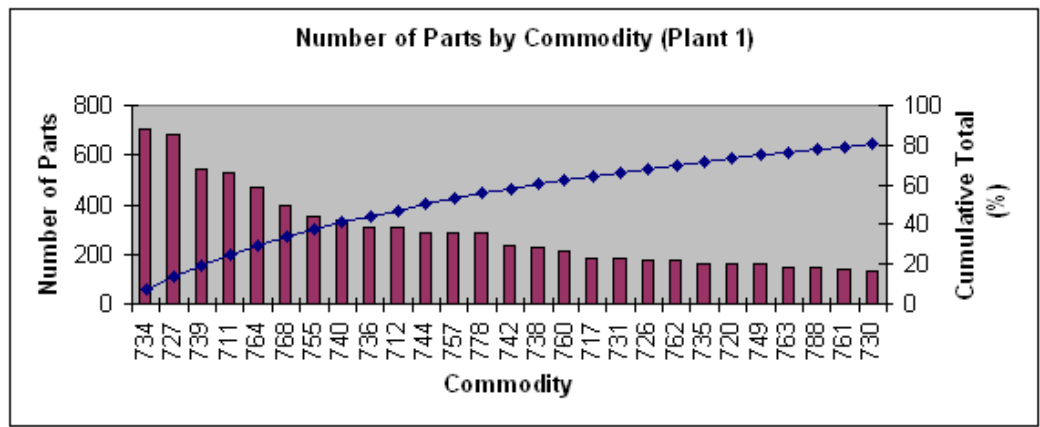


Figure 5-3. The number of parts in each of the most significant commodity groups (the top 80%)

Parts from 27 commodities accounted for 80% of all parts stored at Plant 1.

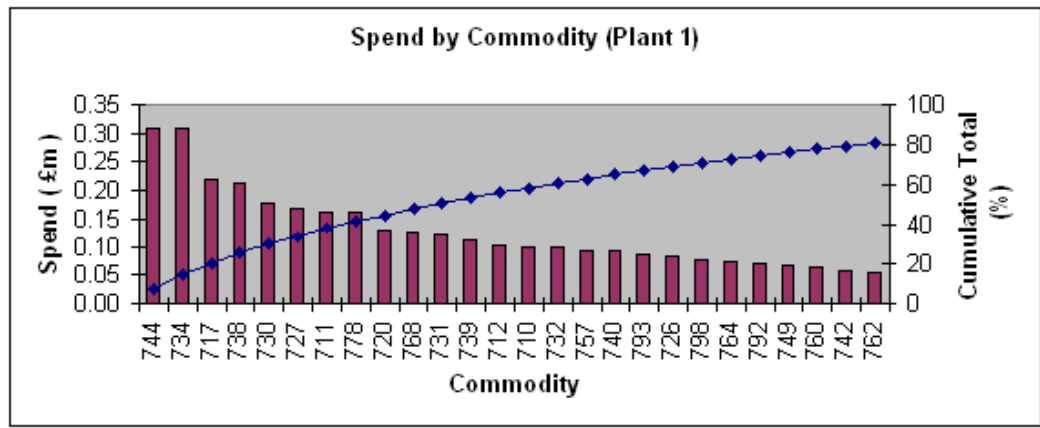


Figure 5-4. Annual spend on the most significant commodities (the top 80%)

Parts from 26 commodities accounted for 80% of spend on parts at Plant 1.

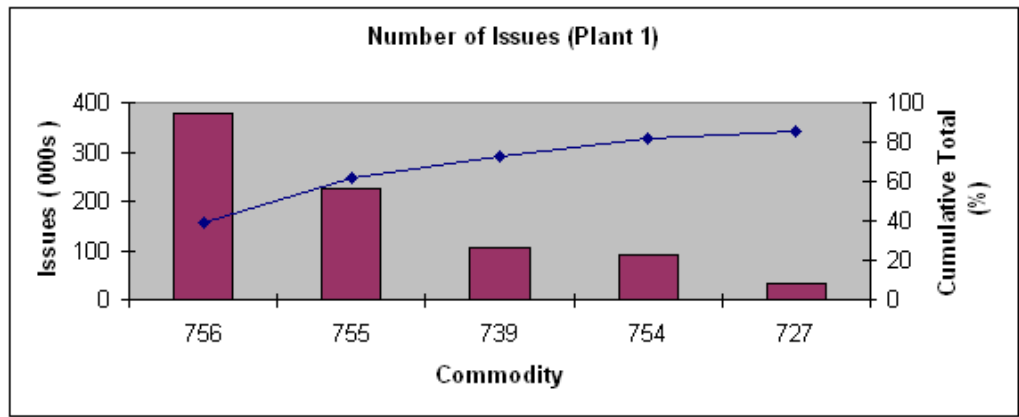


Figure 5-5. The number of issues of parts from the most significant commodity groups (the top 80%)

Parts from 5 commodities accounted for 80% of all issues at Plant 1.

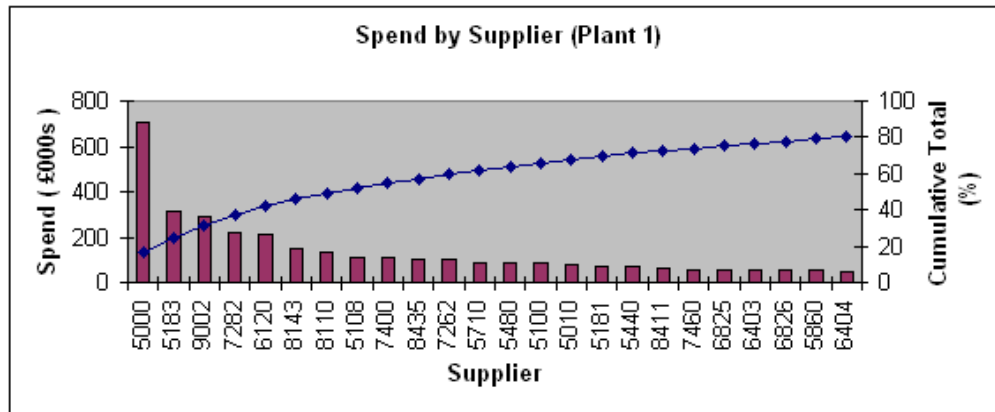
Supplier Analysis

Figure 5-6. The most significant suppliers by annual spend on their parts (the top 80%)

Parts from 24 suppliers accounted for 80% of spend on all parts at Plant 1.

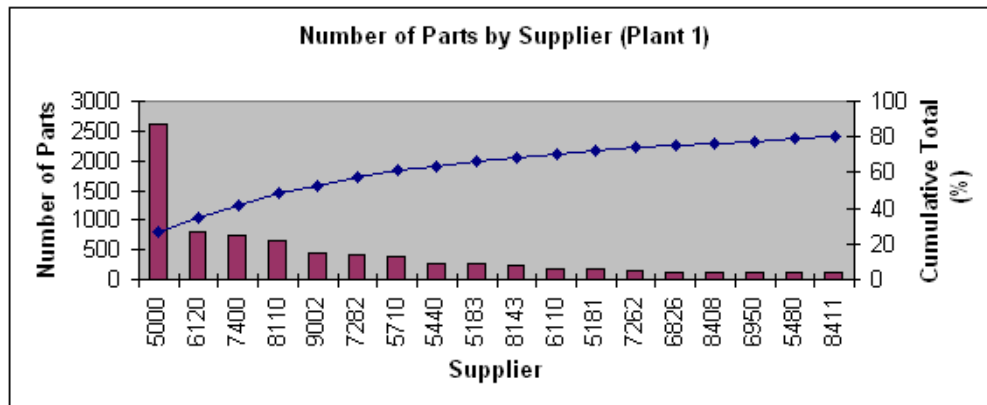


Figure 5-7. The suppliers whose parts account for 80% of the store

Parts from 18 suppliers accounted for 80% of all parts stored at Plant 1.

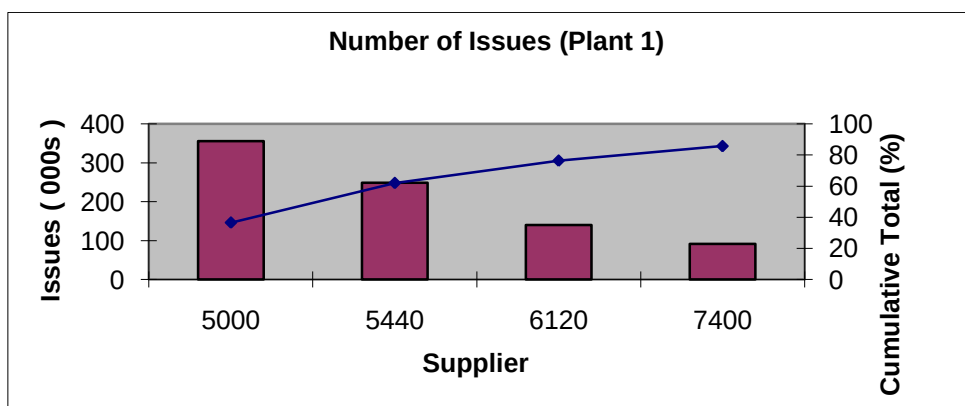


Figure 5-8. The suppliers whose parts account for 80% of issued parts

Parts from 4 suppliers accounted for 80% of all issues at Plant 1.

Commodities and the Suppliers that Supply to Them

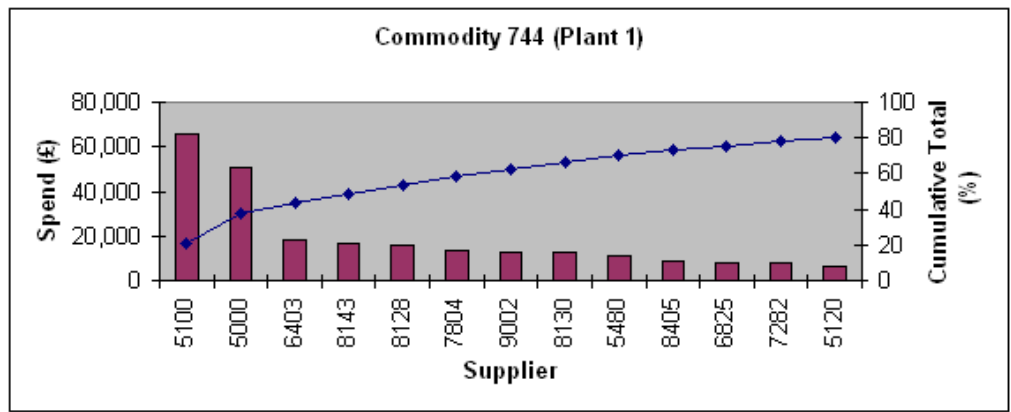


Figure 5-9. The suppliers whose parts account for 80% of spend for commodity 744

For the most significant commodity by spend (744), parts from 13 suppliers accounted for 80% of spend.

Suppliers and the Commodity Groups they Supply To

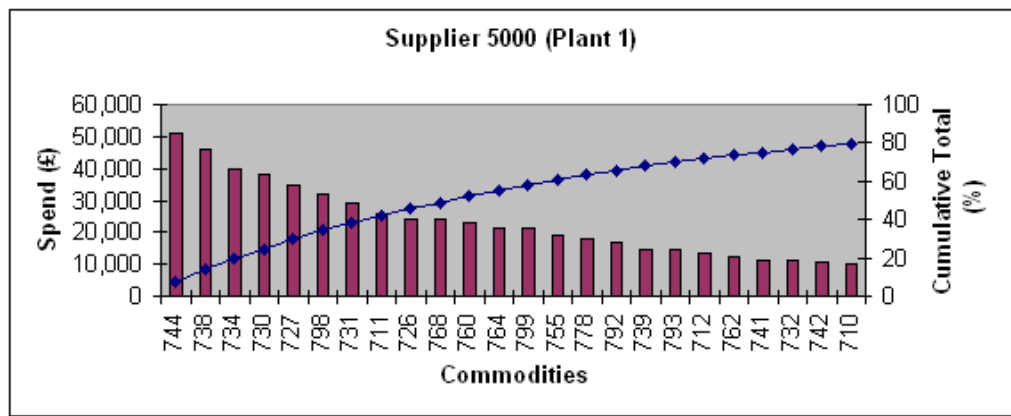
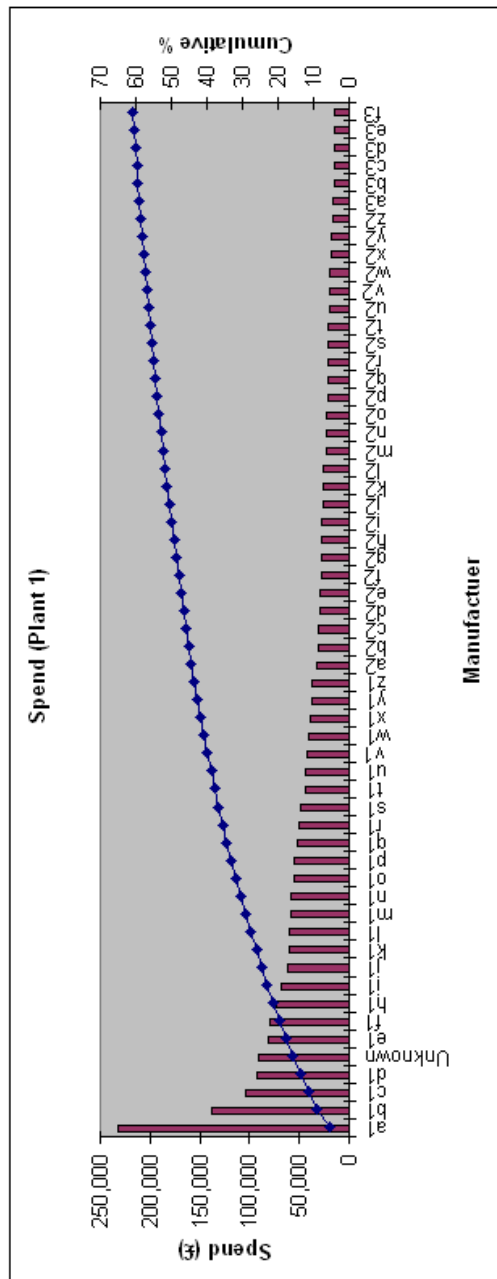


Figure 5-10. The commodities whose parts account for 80% of spend for supplier 5000

For the most significant supplier by spend (5000), 80% of their parts were assigned to 24 commodities.

Manufacturers

Manufacturers vs. Suppliers vs. Commodities

Analysis of the company's data has found that there are at least three main approaches open to investigation. The data can be analysed from the perspective of commodities, suppliers or manufacturers. These perspectives are closely related but still sufficiently different when future solutions and counter measures are considered. Without looking at the data in some detail, it is not clear which is the most appropriate angle to approach the problem from and because the data is so closely related it can become easy to drift between perspectives, making a detailed and ongoing analysis particularly challenging.

The early studies have found that parts from only 24 suppliers accounted for 4/5ths of spend in 2006 (Figure 5-6), which demonstrates that the business is being serviced by a surprisingly small number of powerful suppliers. However, when this issue was raised internally it became clear that the situation came about less through design and more through accident and convenience. If unplanned, such a situation is less than ideal for purchasers as it may lead to an imbalance in supply security. Additionally, the work has found that parts from these suppliers tended to contribute to high inventory levels (Figure 5-7). One further point to note from the supplier analysis is that while 24 suppliers delivered 4 out of every 5 parts bought by the company, 4 out of 5 of issued parts came from only 5 suppliers (Figure 5-8). Therefore, in terms of usage of parts, the business is being serviced by a very small number of suppliers, further increasing the company's exposure to external pressure as well as supply risks.

A supplementary layer of analysis on the base data revealed the inter-related nature of the commodity-supplier relationship. Approaching the problem from both directions (supplier to commodity and commodity to supplier) has revealed that dominant suppliers (such as Supplier 5000) rank highly in the Pareto analysis of suppliers at the commodity level. Also, it has been found that dominant commodities (such as 744) rank highly as a destination of parts for those key suppliers.

Analysing these three perspectives simultaneously it is clear how closely they are related. As can be seen in Table 0-1, Table 0-2 and Table 0-3 in Appendix A, there is a high frequency of shared relationships between manufacturer, supplier, and commodity groups. For example, when considering the top 5 manufacturers as the focus data (as in Table 0-1), it has been found that key suppliers and commodities (as shown in Table 0-2 and Table 0-3) rank highly.

- With manufacturers as the focus data, there are 11 occurrences of key suppliers and 8 occurrences of key commodity groups.

Development of the Skeleton Methodology | Formulating the Skeleton PCRRM

- With suppliers as the focus data, there are 5 occurrences of key manufacturers and 11 occurrences of key commodity groups.
- With commodities as the focus data, there are 8 occurrences of key suppliers and 6 occurrences of key manufacturers.

What this detailed analysis of the base data has shown is that there is a definitive link between cost and risk based around the choice and number of suppliers with which the sponsor company trades. The choices made during the setup of suppliers directly leads to the options available during request for quotations, and in turn, this has a direct impact on the parts held in the general store. The sponsor company is highly exposed to suppliers for which it has no reliable measure of potential exposure to risk. Cost reduction through both sourcing and inventory holding is very tightly bound. Decisions taken during the acquisition phase directly impact on stocking makeup and levels. The successful management of inventory is therefore reliant on both risk and cost reduction.

Field Research – Interviews

In addition to those ideas and concepts discussed during the process of evaluating the current body of knowledge, the author also undertook a period of research in the field to understand the current and pressing needs of the industry. A number of interviews were arranged with key operatives at the sponsor company, and through these interviews the author was able to distil the most significant challenges that the proposed methodology must meet in order to be regarded as a success. The interviews were conducting during the first six months at the start of the Engineering doctorate. Later interviews and open discussions were held during field based research during another six month period in the second year of the programme.

The participants in these interviews and discussions were the following people from the sponsor company:

- Purchasing Manager
- Senior Buyers
- Facilities Manager
- Facilities Operatives
- Plastics Controller
- Accounting and Finance General Manager

It was found that the internal interactions between engineers, users, shops (divisions), managers, designers and other administrative departments all contribute to the current inputs and outputs

of the buyers and how they carry out their day to day purchasing activity. If there are improvements to be made then these interactions need to be better understood. Of particular interest to all the interviewees was the interaction the company has with its main suppliers (set-up, monitoring, negotiations, selection, quotations, changes in business, parts lists)

The culture of the sponsoring organisation was found to be one in which targets and results were clearly defined and frequently reported on. The interviewees were keen to stress that any methodology should be clear in terms of what can be done for quick wins. For the PCRRM to be successful in this and similar environments, it is therefore necessary to design an overall skeleton and individual components which can meet this challenge. In essence, the PCRRM needs to give regular feedback into the overall purchasing and supply management process. More efficient use of web-technologies to interact with suppliers and manufacturers was also discussed at length and found to be an area where the interviewees would seek to investigate opportunities.

From the discussions, the author identified a large overlap between those areas of purchasing and supply management found in the literature which were topics with potential for research and those topics identified in the field.

The practitioners highlighted the reality of the world in which they operate by sharing with the author a number of conflicts that should exist if the PCRRM were to focus on the three components (CSR, sourcing, and inventory) previously identified. Each of these conflicts is now discussed.

Conflict 1: Competitive Pricing versus Sustainable Relationships

Where the PCRRM seeks to reorganise the supply base and increase purchasing price efficiency, there exists a clear tension between cost savings and sustainability. Another issue raised by the practitioners was the extent to which supply would be local vs. global. The extent to which the sponsor company could benefit by focusing its efforts on either local or global sourcing is difficult to assess, and is a clear tension to be addressed by the PCRRM. One possibility raised in the interviews is to open up the IT systems, allowing suppliers to see full usage data but placing more responsibility on them to meet the demand. Where they fail they can be penalised. Alternatively closer relationships with a few key suppliers (consolidated supplier/manufacturer base) might prove more productive.

Key questions for the PCRRM: How to build future best practice given changes in the business and environment? What lessons can be built into a model allowing it to adapt and grow?

Possible formats and features for the PCRRM

- Details of suppliers and manufacturers
- Scenarios
- Strategy, what is the overarching philosophy
- Close relationships, fewer suppliers, more suppliers, market driven, central control, transparent, a closed, reactive, or pro-active.
- Interactive, new-tech
- Decision support
- Knowledge base, the what and the why of previous choices
- Real time, data driven analysis
- User training

This component of the PCRRM should describe strategy at the commodity level and/or the manufacturer level.

Conflict 2: Just-in-Time versus Just-in-Case

Manufacturer/Supplier Parts-Duplication Studies:

There are a number of complicating factors. In essence, this component needs to grasp how much of the stores stock is a duplication of one form or another. The analysis should focus attention on the most important commodity areas, and their respective manufacturers. Parts sheets with specification details are genearily issued but finding the duplication will be difficult for the manufacturer as suppliers often change some or all of the details.

Bonded/Consignment Stock Options:

Bonded/consignment stocking are forms of using an outside agent to store and/or manage the parts on behalf of the company. There are several permutations of location, management and ownership. In addition, there is scope to manage one large contract or setup several small, more specialised contracts with key suppliers or third-parties.

Root Cause of Duplications:

Previous work within the sponsor company has suggested that the mainframe system plays a part in the continued duplication of parts. Details are incomplete and difficult to search for. Engineers with limited time are often ordering parts when there is already an acceptable duplicate in the Store. The system is completely to blame though. There appears to be other areas contributory

factors such as lack of mechanical engineering knowledge in the process (administrative departments not able to vet parts effectively). In addition, it has already been seen that suppliers frequently change the part specification leading to confusion about the actual differences between parts, even for those with a good knowledge of mechanical or electrical engineering. This work might prove very useful in the short and long-term. Initially more duplications might be found and be removed from the Stores and over time fewer parts might be requested.

Understanding the Wider Process:

Why are things stocked, stocked? What is the rationale? It might be useful to know process for the selection of machines that operate on site. This plays a crucial role in maintenance management.

Disposal/Investment Recovery Methods:

It may be possible to implement a market-based investment recovery system. At present the most popular approach to large scale parts disposal is to throw the parts into scrap for removal from site. Other disposal/investment recovery methods need to be investigated.

Use of Third-Party Experts to Rationalise Stores:

While it is possible to outsource the management of stores, a smaller/intermediary step may be to bring in industry experts to visit the stores and make recommendations based on what they find to be duplicated, obsolete etc.

Rationalising the Manufacturer Base for Machine Spares and Other Key Commodity Groups:

Fewer manufacturers and suppliers would reduce complications and over time may help prevent duplications as there would be an element of in built vetting. This topic also links with understanding the rationale behind the selection of machines to be used in production as that plays a large part in future selection of machine spares.

Holding in Different Forms (Child/Parent Parts):

Discussions between the manufacturer and suppliers have highlighted the issue of child parts storage versus parent parts storage. This is to say that complex parts can be held as complete units or in component form. There may be cost savings both in terms of initial spend and storage.

Conflict 3: Risks and Resources

The interviewees had little or no experience with CSR initiatives but were able to raise some interesting questions to challenge the author. If the CSR component of the PCRRM can answer these questions it will become more useful for similar seized manufacturers.

When considering the purchase of a new product or service, how can buyers judge the relative CSR merits of each supplier proposal? What evaluation points need to be considered? How might those fit with price/cost? The evaluation would need to be on a case by case basis.

The key requirements of the CSR component from a practicability point of view can be summarised as:

- **Issue 1.** Would the process be supplier driven or buyer driven?
 - Supplier driven – information supplied with any bid (pre-agreed format) in a similar way to costing information
 - Buyer driven – information requested by the buyer on a case by case basis. Enhanced at later stages in the buying process.
- **Issue 2.** Needs to be succinct/quick/easy to administer.
- **Issue 3.** What form will the results of the process/method actually take?
- **Issue 4.** Focus on the product/service vs. focus on the company.

5.5 Overview of the Skeleton PCRRM

The purpose of this section is to detail an overview of the skeleton PCRRM (Figure 5-12) and its final makeup once populated.

Components

For any proposed methodology to be successful, it must be well structured and designed to meet the needs of the end users, whether they are academics, practitioners, or both. To understand how the PCRRM should be designed, the author consulted the literature base for examples of similar works in related areas as well as undertaking interviewees with practitioners in the field. The findings and strategies for methodology structure put forward by Chandraprakaikul (2008) and Platts (2004) were found to be of excellent quality and strong relevance for the work presented in this thesis and have therefore formed the basis for the authors own approach to the configuration of the methodology and its components.

By bringing together these strands of research, it has been possible to identify the major components that the PCRRM will contain. The outcome of this process has been the construction of a skeleton methodology. This skeleton sets out the major components of the PCRRM and how

they relate to one another. In doing so it is then possible for the author to establish a series of deep studies into each component in order to add the 'flesh' to the skeleton.

The skeleton methodology is set out below and forms the basis for the studies that follow in later chapters in this thesis. Each subsequent chapter adds the detail to the associated component of this skeleton methodology in order to meet the research objectives set out in earlier chapters of this thesis.

The PCRRM provides defines the overarching philosophy and purchasing strategy to be practised within Corporate Services. It details a clear argument for the rationalisation of the supplier base. It shows how the selection of suppliers should be carried out and what criteria should be used when considering sourcing options. The relative weighting of these variables is presented as a formula that can be applied on an ongoing basis. It outlines how the 'closeness' of a supplier relationship impacts on current and future costs.

This will transform the purchasing process from reactive to proactive and leverage the skills of the buyers to bring real benefit to the company. The PCRRM will consist of written documents and a computer based tools, allowing ongoing analysis and planning of the situation. Through the PCRRM, the rationale behind sourcing decision becomes clearer and contributes to the knowledge base. The work is managed in concert with other efforts in the company, but drives the process in a new direction, away from short-term fixes to medium-term step changes.

Three investigations, one for each components are:

- Sourcing
- Inventory
- CSR

Three targets for validating the components:

- Sourcing – saving on spend compared to the previous year.
- Inventory – saving on spares holding value.
- CSR – enhance the sponsor company's social responsibility risk capture and analysis.

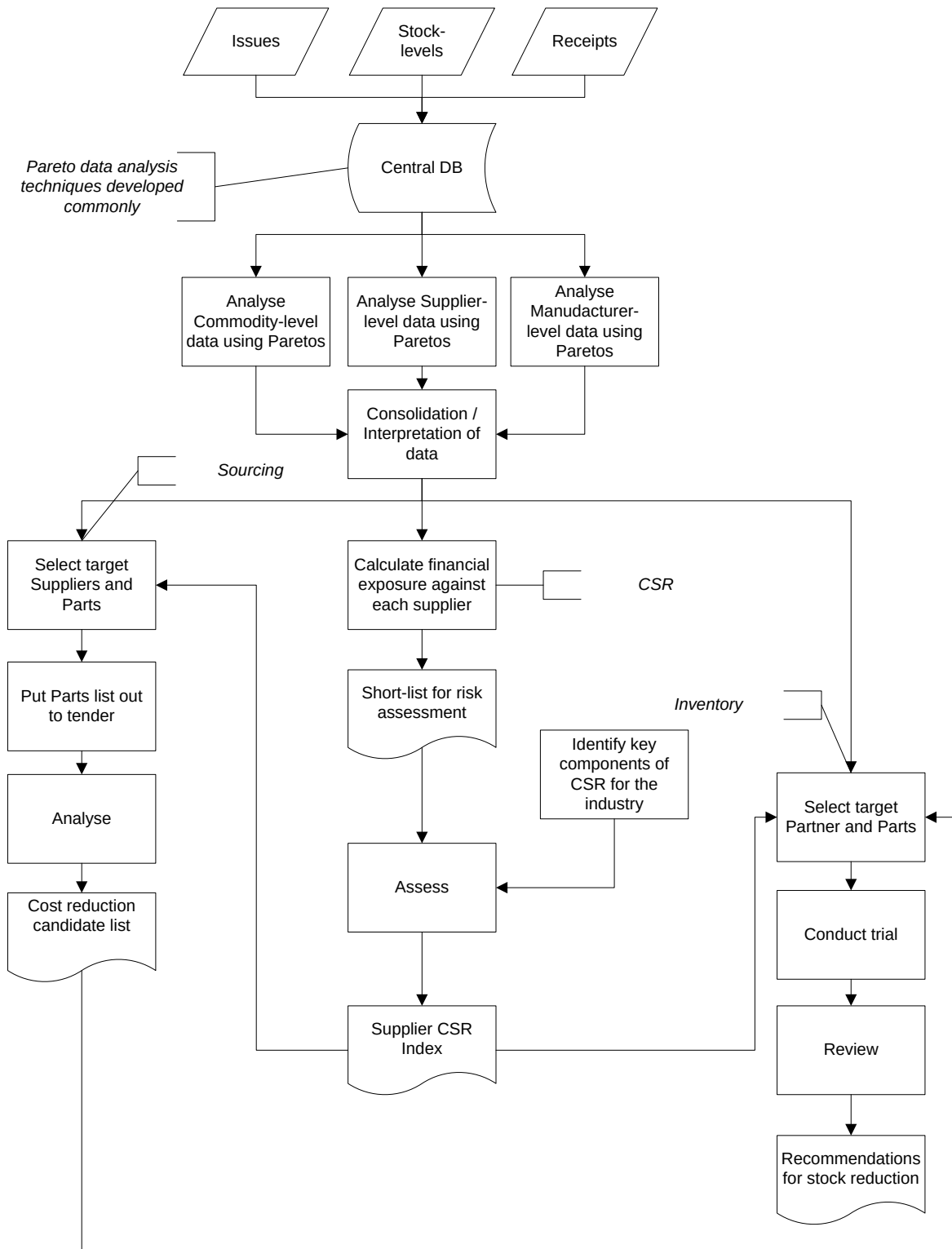


Figure 5-12. Skeleton PCRRM

Figure 5-12 shows the skeleton methodology designed based on the findings of the literature review and preliminary data analysis carried out in the purchasing field. The skeleton is structured in two key stages. The first of these stages is the gathering and cross referencing of base data. The second is the analysis of this data through three streams of processing. Costs are analysed through the sourcing stream, risk are analysed through the CSR stream, and inventory is analysed through the inventory stream. The three streams interconnect and form a feedback loop. The results of the CSR analysis feed into both sourcing and inventory analysis and the results of the sourcing analysis feeds into the inventory analysis. The skeleton methodology sets the framework into which the individual component studies described in subsequent chapters of the thesis sit.

5.6 Summary

This chapter has presented the work undertaken in the development of the skeletal structure of the Purchasing Cost and Risk Reduction Methodology (PCRRM).

The chapter began by setting out the summarised findings from the literature and discussion on each of the likely components to be present in the proposed methodology. Points and concerns raised through discussions with industrial purchasers were then set out. The issues and suggestions made by the interviewees were then discussed in the context of each component of the PCRRM.

The chapter concluded by defining the skeleton of the PCRRM and the delivery mechanism chosen for this programme of research.

Chapter 6

Corporate Social Responsibility Study

6.1 Introduction

This chapter explores the process of evaluating an automotive manufacturer's supply base against socially responsible criteria. More specifically, it describes the development of a structured approach to corporate social responsibility (CSR) assessment of suppliers and partners. The chapter begins by discussing the matter CSR and the issues relating to its measurement and monitoring. The main body of this chapter presents a structured approach to tackling these issues developed through literature and field research. Firstly, a process for the selection of suppliers for evaluation is described. Secondly, a process for evaluation of suppliers is described. The results from the execution of these processes in a live environment are then presented and discussed.

6.2 Chapter Structure

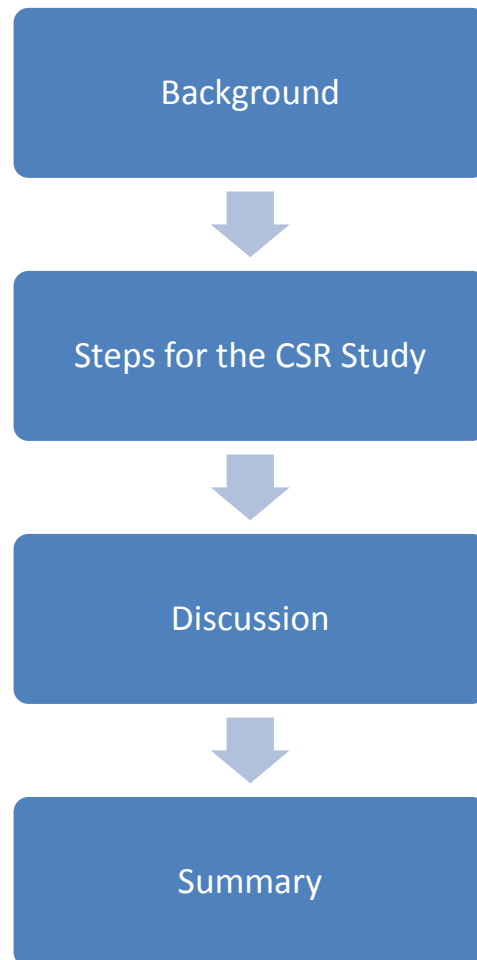


Figure 6-1. Chapter structure

6.3 Background

This section presents the aim and objectives of the study and the practical considerations that were necessary in order for the research to take place in a live environment.

The purpose of this study

In recent years it has become apparent to many organisations that they can achieve publicity and marketing benefits through obtaining certifications awards for their CSR policies and practices. Those that participate in rating schemes that publish league tables for CSR performance are required to demonstrate adherence to socially responsible practices (e.g. Business in the Community www.bitc.org.uk). In such schemes, the precise method of meeting the requirements is left largely in the hands of the participating companies. While this freedom can bring the benefit of innovation to a new discipline, it can also leave room for confusion. When dealing with soft management sciences such as CSR, organisations want to record and evaluate their position in a fair and repeatable manner. One important element of this is the implementation of a CSR auditing framework into their supply chain management procedures.

The aim of this study was to investigate the formalisation of the CSR issues. In particular, the study sought to develop a repeatable process to identify the suppliers to be audited by the sponsor company base on a suspected weakness in the supplier's policies and/or practices. To do this, it was necessary to establish an authoritative yet practicable means of identifying participants for the assessment and then to administer a traceable as well as repeatable CSR competency assessment. The objectives of the study which led to this aim were:

- To identify the most risky suppliers and target them as the first intake of respondents
- To establish the extent to which first-tier suppliers were meeting CSR competency levels and to make that assessment comparable and quantifiable
- To produce a repeatable and adaptive process that would be seamlessly integrated into the wider process of a major automotive organisation

The findings from this study are used to populate the Purchasing Cost and Risk Reduction Methodology (PCRRM) skeleton as presented in Chapter 5 of this thesis (Figure 6-2).

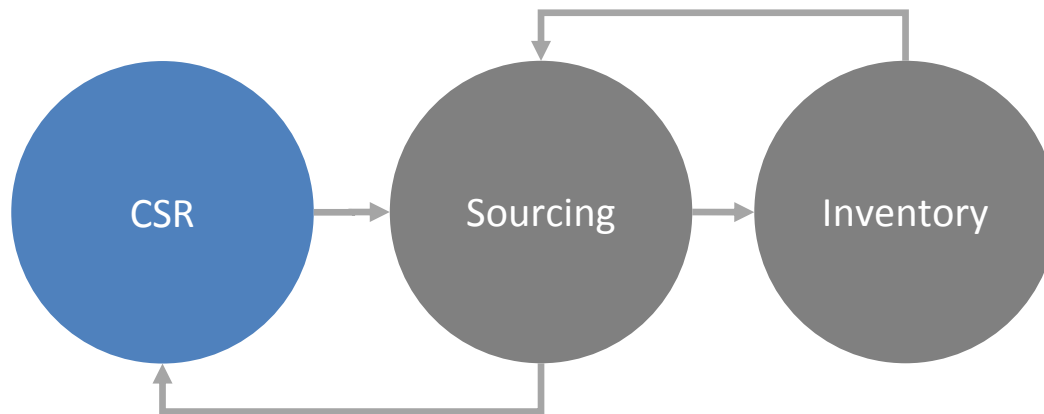


Figure 6-2. Components of the PCRRM

Practical considerations

The study described in this chapter was conducted in a real world context. It would not have been possible to run the study without the approval of each of the sponsor company's senior management and in particular the approval of the purchasing manager. The sponsor company expressed the view that if the findings of the study were to be implemented in the company then they should be sympathetic to the needs of a real world operation and not merely the product of a purely theoretical exercise. Although these requests were not binding on the author, it was felt that these issues were in fact central to the study in terms of future generalisability and therefore useful considerations to be taken into account. In addition, the author also felt that by designing the study to be sympathetic to these issues, the CSR component of the PCRRM would be more robust and therefore more easily validated in later stages of the research programme.

The responding companies were known to be dispersed throughout the UK. Therefore, the method of approach to respondents would have to be practicable and easily repeatable. The most traceable and easily managed means of communicating with a geographically scattered participant base was to use an online questionnaire to ascertain their CSR risk profile based upon key proficiencies laid out in subsequent sections of this chapter.

The intended participants were employees of first-tier suppliers of the company. With each of these companies having their own internal structure and responsibility definitions it was not possible to predict the end respondent. In some cases, the participant in the supplier organisation may be a buyer or quality expert with substantial experience, in others he/she may be an administrator or other non-specialist. This uncertainty meant that the questionnaire would need to be structured in a broadly accessible way that would allow different types of participants

to make the most of its features. The questions to be asked of the respondents were designed to be thorough but not overly burdensome.

The key actors were identified as being:

- Purchasing Manager – Overseeing the process in the sponsor company
- Administrators – Shadowing the author to learn the process for inclusion in future runs
- Advisers – Experienced buyers in the sponsor company who could advise on crucial areas
- Evaluators – Administrators and buyers in the sponsor organisation who could draw upon personal experience and sponsor company policy documents to make fair assessments of participants' answers
- Respondents – Individuals that completed the questionnaire on behalf of the first tier suppliers. These may be experienced senior staff members or less experienced administrators
- The Author – The designer and implementer of the study

6.4 Steps for the CSR Study

This section presents the two steps of the CSR study (Figure 6-3). Each is discussed in terms of its aim, method of development and implementation, and rationale. Both steps of the investigation were conducted in the field.

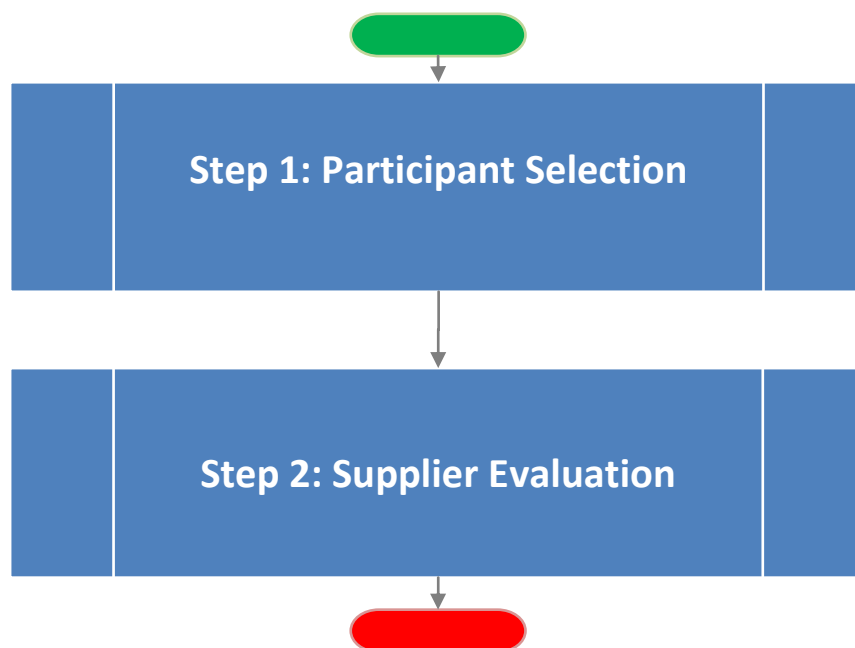


Figure 6-3. Steps of conducting the CSR study

Step 1: Participant Selection

Aim of this step

The purpose of this step was to identify a list of suppliers to be sent the CSR competency evaluation questionnaire described later in this chapter. The supplier base of the sponsor company numbers over 800. The participant selection step reduced that number to 20 participants for evaluation. In order to do this, the investigation sought to identify which suppliers constituted the greatest risk and therefore should be evaluated soonest. The process was developed to incorporate two components of risk calculation, namely, the financial exposure the sponsor company had to each supplier and the inherent risk of the supplier's business model and operations. It was important also to identify the supplier companies that should be sent the CSR evaluation in a repeatable and integrated way. The objectives of this step were therefore to:

1. Identify candidate participants
2. Identify participants from candidate list
3. Develop a repeatable and integrated process

How it was done

Rank suppliers by financial exposure: The first stage in selecting participants for the CSR evaluation was to identify candidate participants that would be put through the pre-evaluation assessment. This meant identifying from a database of around 800 suppliers which of them should be assessed by experienced buyers and selected for the full CSR evaluation.

Firstly, the spend data from the previous year was downloaded from the central database. This data was in the form of individual transactions for the purchasing of consumables, machine spares, and services. Some transactions were conducted in currencies other than GBP, therefore it was first necessary to convert these values. Once this had been done, a pivot table was created to group transactions by each supplier and give a total spend for each of them. Following this, a Pareto analysis on the spend data was carried out to identify the suppliers which together accounted for 80% of total spend in the previous year. From the 800 active suppliers, it was found that just 77 accounted for 80% of total spend.

Process flowchart: Figure 6-4 shows the main stages in conducting the participant selection.

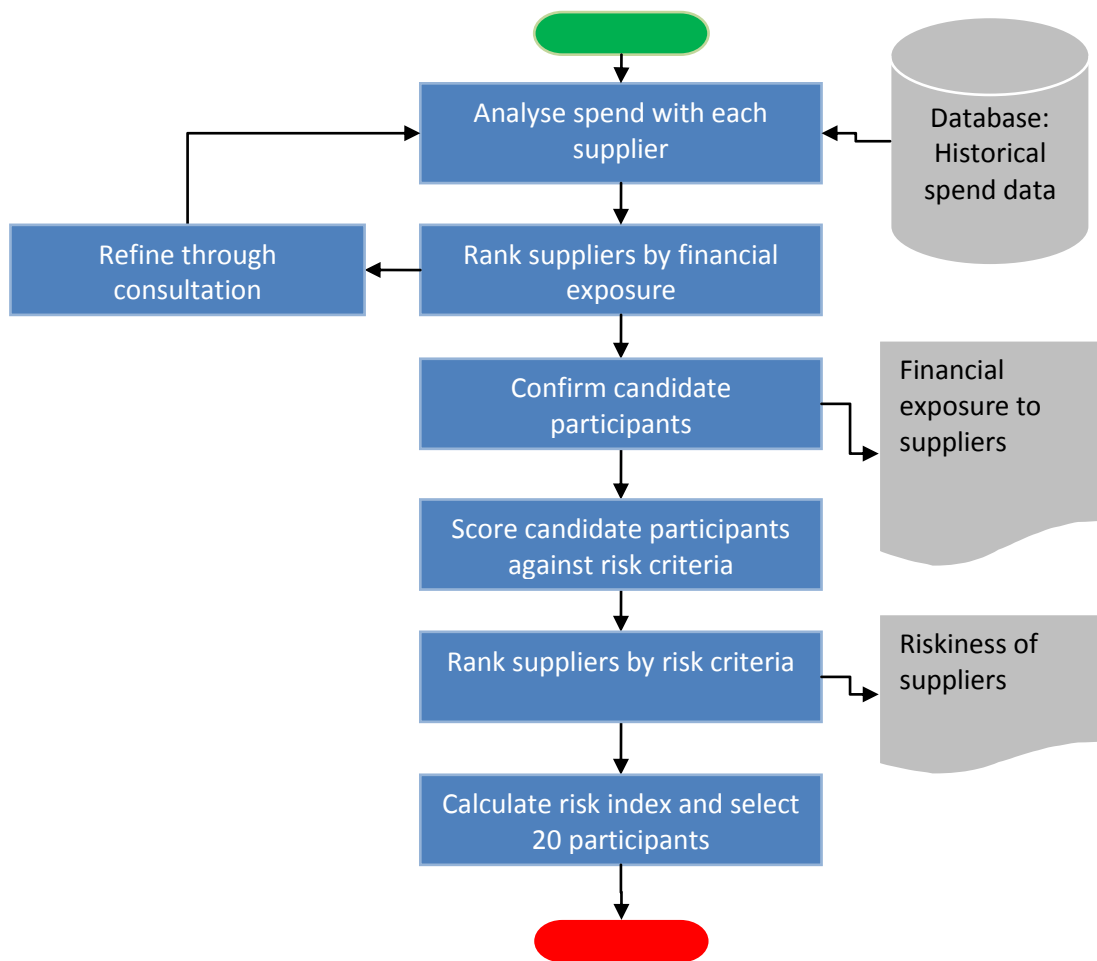


Figure 6-4. Participant selection process

This list of 77 suppliers was presented to the purchasing manager for scrutiny. The purchasing manager identified 7 suppliers on the list that would not be useful for the study. These suppliers were no longer trading, had been absorbed into another supplier's operations, or were not likely to be used in the future for other business reasons. With the spend data totalled for each supplier, it was then possible to rank those 70 remaining suppliers in order of spend. This was the list of suppliers that would then be used in the pre-evaluation assessment.

Confirm candidate participants: The second stage in selecting participants for the CSR evaluation was to reduce the list of 70 candidate participants down to 20. This meant identifying from the 70 suppliers with whom the sponsor company was most financially exposed, and which were also perceived to be the most uncertain in terms of CSR related issues.

This was achieved by drawing upon the experience of the purchasing department's buyers to conduct a pre-evaluation assessment of each supplier against criteria set out in the sponsor company's supplier responsibilities documentation (Table 6-1).

The scoring of each supplier was carried out by one buyer. The purchasing manager suggested a buyer to assess each supplier. The initials of the buyer were then put in the participants selection tool spreadsheet before being placed on the company network to allow access (Figure 6-6). For each question the buyer would give a mark on three-point-scale, which in their judgement, represented the suppliers competence or compliance (mimicking the sponsor company's internal assessment system). Each supplier's total score was used to rank it in order of perceived risk.

In addition to the scoring element, this stage of work also requested that the buyers provide contact information for each of the supplier companies, including a named person and his/her email address.

Calculate risk index and select 20 participants: The final stage in selecting participants for the CSR evaluation was to combine the two measures of risk into a total score for each supplier. To do this, the rank from the exposure analysis and the rank from the pre-evaluation assessment were multiplied to give a final score. In effect, the lower the product of the two ranks the lower the potential exposure of the company. Doing this ensured that the final outcome took account of both important elements of risk to the sponsor company's supply chain viability.

$$\text{Risk Index} = \text{Practitioner Assessment Rank} \times \text{Exposure Rank}$$

The 20 worst performing suppliers were selected as questionnaire candidates using this figure. This figure was set to be customisable for future runs of this work by altering the setup sheet included in the participant selection tool spreadsheet. The scoring and cut-off points for inclusion in the was setup with aid of variables as presented in Figure 6-5.

Selection tool/template: The participants selection tool (Figure 6-6) was brought all these elements together into a single and reusable tool. The tool was developed in a spreadsheet document with colour coded sections. The tool was presented to the buyers in one of the weekly department meetings and the first sheet in the file repeated instructions for usage. The assessment points were developed through consultation with the purchasing manager, the buyers in the department, and through reference to internal company documentation.

Table 6-1. Practitioner assessment themes

Product	Process	Treatment of People
- Product materials (recycling) - Product materials (risk or concern to health) - Packaging (waste) - Sustainability of sources	- Environmental impact of processes - Un-recyclable materials - Impact of substances - Waste disposal - Workers'/community environment	- Workers' rights - Working practices - Health and safety - Employees' terms and conditions

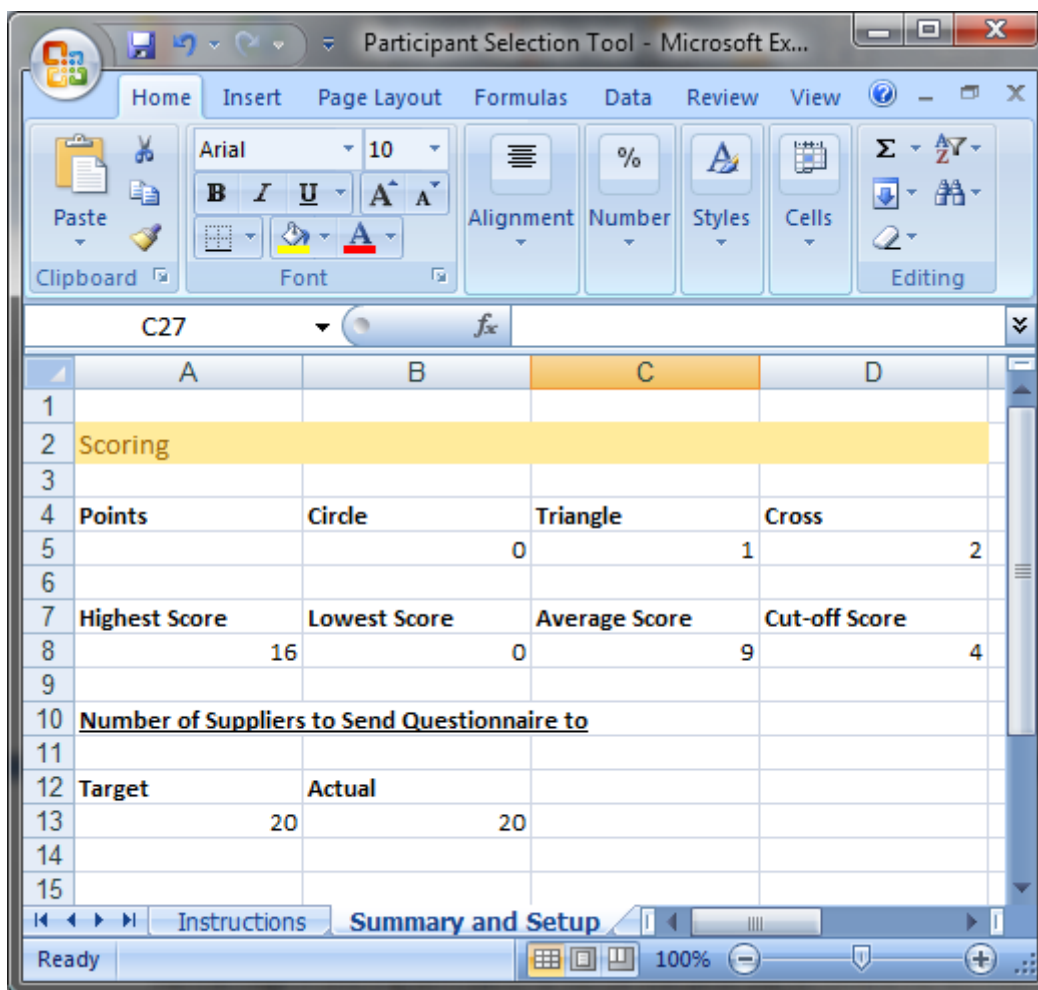


Figure 6-5. Participant selection tool setup

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
	Supplier Code	Supplier Name	Buyer Name	Suggested Person (Name)	Suggested Contact Person (Email)	PRODUCT: Are the products made of recyclable material	PRODUCT: Material used represent no risk or health concern	PRODUCT: Packaging is kept to a minimum	PRODUCT: Materials are from sustainable sources	PROCESS: The manufacturing process or service is conducted in an environmentally friendly way	PROCESS: Minimal/Zer o waste is generated by the process that cannot be recycled	PROCESS: Substances used are confirmed for their environment al impact	PROCESS: There is a sound and ally friendly waste disposal method	PROCESS: The process does not create a poor environment for workers or the local community	TREATMENT OF PEOPLE: Workers' human rights are treated with respect	TREATMENT OF PEOPLE: Employees are not subject to dangerous working practices	TREATMENT OF PEOPLE: Health and safety is the supplier's priority	TREATMENT OF PEOPLE: Employees' terms and conditions meet all local and prevailing laws	Comments (Optional)	Pre-evaluation Assessment	Exposure Risk	Risk Index		
1	5763	Supplier 9	TE	Name	name@supplier.com	2	1	1	2	1	1	1	1	1	1	1	1	1	1	15	65	57	3705	Yes
2	7951	Supplier 12	TE	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	2	2	1	1	16	68	50	3400	Yes
3	53898	Supplier 2	LP	Name	name@supplier.com	1	1	2	1	1	1	2	2	0	1	1	1	1	1	15	65	51	3315	Yes
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58	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
59	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
60	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
61	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
62	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
63	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
64	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
65	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
66	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
67	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
68	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
69	53898	Supplier 2	LP	Name	name@supplier.com	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15	65	51	3315	Yes
70	53898	Supplier 2																						

Why it was done in this way

In an ideal scenario, it would have been possible to conduct an evaluation of the complete supply base and so judge the strengths and weaknesses as a whole. However, in a real world context this was not possible for a variety of reasons. Firstly, time and resource constraints meant that while it would be possible to administer a partially automated process of evaluation, there would be manual steps required to ensure that the study was being conducted in fair and accurate manner. Secondly, as the output of the process is the identification of candidates for audits, it would not be useful to produce a list of such a size that would prevent the majority of identifications from being possibly considered. That is to say that despite its size the sponsor company, (and any other large enterprises), cannot afford to devote limitless manpower to handling the outputs of the process. What is more important is to identify the most likely and most important areas of concern sooner, and work through the remainder in later cycles or progressive implementations.

The sponsor company requested that the study be conducted as a trial and be limited to a sample of supplier companies. Their justification for this decision was that they have a strong preference for a gradual implementation of a new process that allows them to judge its usefulness and areas for improvement before it is rolled out. In addition, they would need time to assimilate the process into their operations whilst not detracting the purchasing team from pressing concerns.

It was felt that 20 companies would be a sensible figure to work with. This number would ensure that likely issues were identified and leave open the possibility of an alternative system to be put in place if the study was rendered unmanageable or broke down due to its potential harm buyer-supplier relationships.

There are two key considerations when making the selection of participants for a CSR evaluation. The first of these is the financial exposure the business has towards each of the suppliers.

Rank suppliers by financial exposure: The exposure analysis was crucial to allow for the selection of suppliers for pre-evaluation. It would not have been practicable for the buyers in the department to make an assessment of the 800 strong supply base in a timely and effective manner.

The exposure analysis made use of the purchasing spend data because it gives an accurate and quantifiable assessment of the significance of a supplier to the sponsor company. When analysing the trend of machine spares and general consumables usage it can be very difficult to make an accurate forecast of likely spend in a future year. However, by making use of the most

recent years spend, it is possible to show that a supplier has been shown to be a significant trading partner in the past and would therefore be likely to be a significant partner in the near future.

The Pareto analysis provided a useful means of identifying from the supply base those suppliers who accounted for the vast majority of inputs under investigation within the sponsor company. Using this approach, the suppliers who represented relatively small total spend were eliminated as early as possible from the process, thus increasing the effectiveness of later stages of the investigation by concentrating efforts on the most important areas. It was useful to incorporate the purchasing manager's experience and knowledge to refine the list of 77 suppliers down to 70 as this also saved time for the buyers when making their assessment. By incorporating this inside knowledge as soon as possible, future stages of the work were not delayed by the need to revise the list of suppliers. Ranking the suppliers by spend allowed this analysis to be used in creating the risk index. It also gave an easy to understand and easily repeatable means of including the exposure analysis in the risk indexing calculation.

The exposure analysis was required in this step of the CSR evaluation process because it provides a critical element for the consideration of whether a supplier should be audited. Resourcing business from a major supplier is more difficult than resourcing business from a relatively small supplier. Therefore, it makes sense that when considering which suppliers should be evaluated and later audited, an organisation such as the sponsor company should look at largest areas of exposure first. The greater the level of business with a supplier, the more opportunities there are for problems to arise. Financial exposure rank handles this by identifying a subset of the complete supply base that account for 80% of the annual spend. In this way, the business can be assured the most significant areas first. In addition a larger supplier is more likely to have a greater supply base than a smaller supplier, and therefore greater total exposure. Therefore, it once again makes good sense to consider those suppliers that expose the organisation to the greatest to supply chain and therefore provide the greatest opportunity for CSR difficulties.

Confirm candidate participants: The second key consideration in selecting participants is to ensure that those suppliers who are known to be the most likely to have CSR issues are identified early in the process. There are three main attributes to any company's CSR risks; these are their product; their process; and the treatment of labour. This is handled in this process by capturing the experience of buyers and formalising that knowledge. A simple scoring mechanism, such as a three point scale, is sufficiently robust as to allow areas of concern to be identified whilst not becoming overly burdensome for the buyers. Making use of a specific buyer for each assessment

makes it more likely that each supplier will be scored rather than leaving it open to choice. This method also removed the chance of duplicated completion and therefore wasted effort on the part of the buyers. Using the total of the three categories (product, process, and treatment of people) gives a balanced view of the considered inherent risk of the suppliers operations and business conduct. The ranking of this score makes it possible to utilise this pre-evaluation assessment in the overall calculation of the risk index.

Risk index: The risk index is an important final stage because it allows the distinct components of financial exposure and buyer experience to be brought together and produce quantifiable justification for the inclusion of a supplier in any later CSR evaluation. The risk index uses the product of the two components in an equally weighted way. This gives equal precedence to each component of risk, although it would be a simple task to apply a different weighting scheme.

Tool: The tool was a useful final product because it brought together the two most important means (financial exposure and level of risk) of judging whether a supplier should included in a future evaluation together into a single document that could be reused in future years. The tool also reduced the number of calculations and considerations that would otherwise have been necessary by as far as possible automating the process of participant selection. The tool was also easy to integrate into wider operations because it made use of standards of documentation and assessment already present in the sponsor company. The tool also made it possible for future iterations of this process to fine tune to number of suppliers to be included by manipulating the setup figures. This gives the tool greater flexibility for use in the future.

Step 2: Supplier Evaluation

Aim of this step

The purpose of the supplier evaluation was to partially automate the process of scoring supplier CSR competencies and assessing their relative areas of concern. The step used the raw data from the online questionnaire and generates an easily understandable. A process was also needed to ensure that the evaluation of CSR competencies could be carried out in a timely and repeatable fashion. It was important to the wider process that communications with suppliers should be traceable and that problems could be identified and resolved as quickly as possible. This process therefore sought to encourage supplier involvement through the dissemination of necessary information for the completion of the questionnaire. The objectives of this step were therefore to:

1. Develop CSR competency assessment questionnaire

2. Establish an evaluation management process
3. Develop a method for quantifying CSR competency
4. Identify suppliers for CSR audit

How it was done

Process flowcharts: Figure 6-7 shows the main stages in conducting the supplier evaluation.

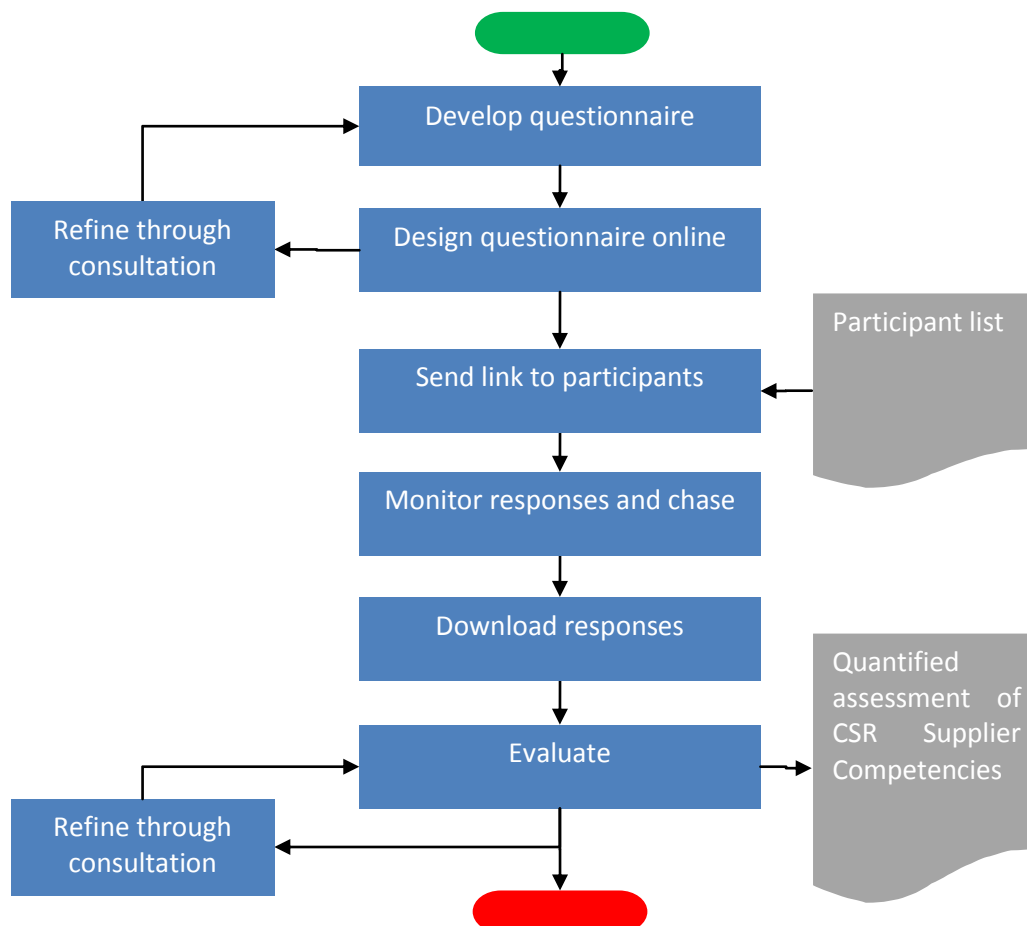


Figure 6-7. Supplier CSR competency questionnaire development and administration process

In conjunction with this, it was necessary to put in place a system for monitoring progress of suppliers in completing the evaluation questionnaire and chasing those that had yet to submit their responses. Figure 6-8 gives an overview of the process conducted in managing communication with suppliers and encouraging them to participate.

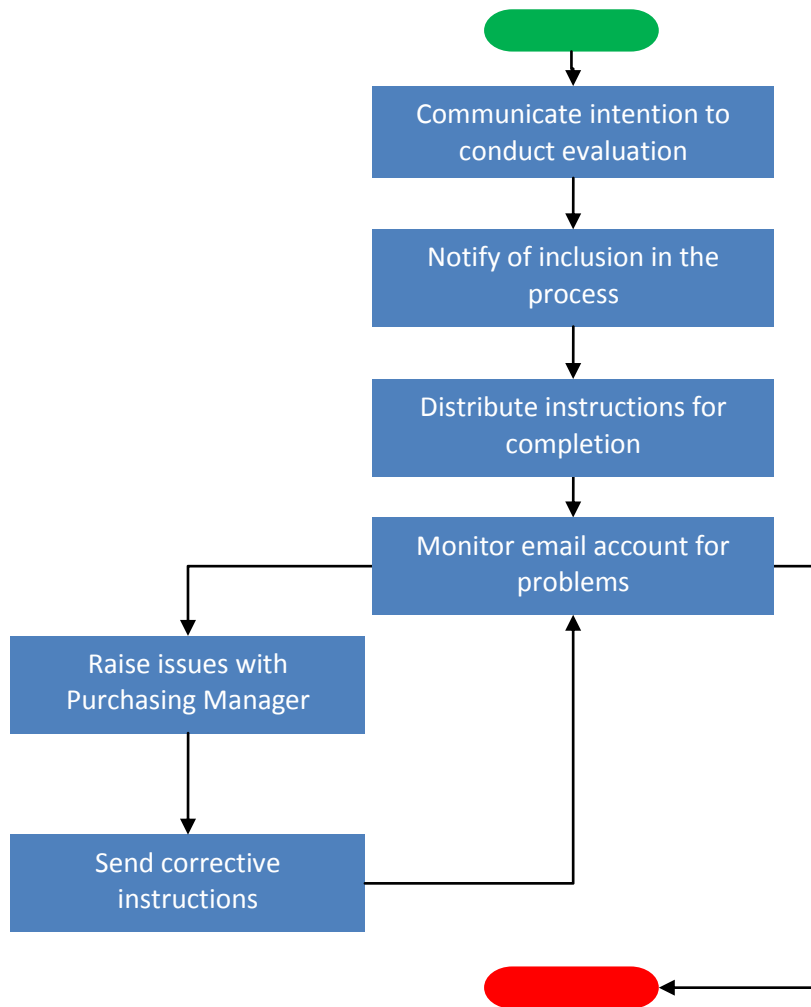


Figure 6-8. Overview of the participant engagement process

The Questionnaire

The supplier companies identified in the previous step of this study were sent a questionnaire to assess their CSR competencies. The questionnaire was administered online with a carbon copy spreadsheet version for those suppliers who were for technical reasons not able to complete the questions online. Positive/desired responses received 1 point with each section having a maximum number of points available. The results of this were then weighted against the relative importance of each category of questions to derive an overall score and identify suppliers for CSR audit.

Development of sections, questions, and response options: The questionnaire was developed with five main sections. The titles and the content they would address were derived from both the literature review and discussions with the sponsor company. The sections identified were:

1. General – High level questions aimed at understanding the general competency of the supplier
2. Workforce – Sought to capture the efforts the supplier has made to ensure proper employment and working conditions
3. Environment – Dealt with the environmental impact of the supplier's processes and products
4. Community – The extent to which the company positively engages with their local community
5. Supply chain – Looked for evidence that the supplier was making similar investigations in their supply base

General: The first section presented to the participants was a set of questions related to non-specific areas of their company CSR policy. Each of these questions required a direct yes or no answer. Where respondent answered no, they were asked to provide additional information. The questions asked in this section were:

- i. **Do you have a corporate social responsibility (CSR) policy?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}
- ii. **Do you have a senior representative who ensures corporate social responsibility standards and targets are met?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}
- iii. **Do you include corporate social responsibility in your risk management process?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}

Workforce Rights: The second section of the questionnaire asked respondents to answer questions relating to the treatment of their workers and the health safety issues. The majority of these questions were again structured as direct yes or no answers, with the respondent asked to provide additional information where they had indicated no competency. However question 5 required the respondent to give a more detailed answer through the use of multiple selections from a predefined list. Where the respondent made no selection they were asked to provide further information. Respondents were also able to provide additional information if the options list did not include a management method that they implement.

- iv. **Do you have a policy on the provision of a safe and healthy working environment**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}
- v. **How do you manage health and safety policy?**
 - a. Audits
 - b. Periodical retraining
 - c. One-off induction training
 - d. Verbal communication
 - e. Questionnaires
 - f. None, Not known
 - g. Other
 - h. {If None, Not known, how do you manage health and safety policy? Please provide details of corrective actions and timings}
 - i. {If Other, please provide details}
- vi. **Do you successfully meet all applicable legal responsibilities with regard to employee working hours (daily/weekly hour limits, rest breaks, paid leave entitlement etc)?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}
- vii. **Do you have a policy outlining your responsibilities to employees to provide fair compensation in line with industry and market norms?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}
- viii. **Do you have a policy on non-discriminatory employment practices relating to; race, gender, beliefs, orientation, age, and disabilities?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}
- ix. **Do you have a policy on non-discriminatory employment practices relating to; union membership and/or political affiliation?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}
- x. **Do you have a policy that has established disciplinary procedures?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}

- xi. Do you have a policy prohibiting the use of labour under the legal minimum age (in accordance with local laws and international agreements)?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}

Environmental Considerations: This section gathered information regarding the environmental impact that the respondent's company had in terms of products and processes, as well as the management systems they have in place to deal with these issues. The majority of questions in this section required the respondent to select from a predefined list of competencies and methods with the opportunity to provide additional information where possible.

- xii. Do you have an environmental management system?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}
- xiii. How do you minimise waste, energy usage, water usage, air pollution/CO2 and noise in your production processes?**
 - a. Audits
 - b. Periodical retraining
 - c. One-off induction training
 - d. Verbal communication
 - e. Questionnaires
 - f. None, Not known
 - g. Other
 - h. {If None, Not known, how do you minimise waste, energy usage, water usage, air pollution/CO2 and noise in your production processes? Please provide details of corrective actions and timings}
 - i. {If Other, please provide details}
- xiv. How do you minimise your product's environmental impact?**
 - a. Audits
 - b. Periodical retraining
 - c. One-off induction training
 - d. Verbal communication
 - e. Questionnaires
 - f. None, Not known
 - g. Other

- h. {If None, Not known, how do you minimise your product's environmental impact? Please provide details of corrective actions and timings}
 - i. {If Other, please provide details}
- xv. **What proportion of your waste (non-water) is disposed of via {Up to 5%, Up to 10%, Up to 25%, Up to 50%, Over 50%}:**
 - a. Landfill
 - b. Incineration
 - c. Supplier collection scheme
 - d. Recycling centres
 - e. Unknown disposal method
- xvi. **What proportion of your water waste goes to {Up to 5%, Up to 10%, Up to 25%, Up to 50%, Over 50%}:**
 - a. Re-use
 - b. Run-off / drainage
 - c. Specialist substance removal
 - d. Unknown disposal method
- xvii. **Do you have a programme for continually improving your environmental performance?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}
- xviii. **Have you attained relevant ISO14001 certification (and/or others where applicable)?**
 - a. Yes
 - b. No, but plan to
 - c. No, no plan to
 - d. {If No, but plan to, have you attained relevant ISO14001 certification (and/or others where applicable)?
 - e. Please provide details of corrective actions and timings}
 - f. {If No, no plan to, have you attained relevant ISO14001 certification (and/or others where applicable)?
 - g. Please provide details of corrective actions and timings}
- xix. **Do you have a policy for the safe disposal of materials already on site (e.g. controlled waste, general waste)?**
 - a. Yes
 - b. No {Please provide details of corrective actions and timings}

Community Involvement: This section of the questionnaire asked to provide confirmation that they take the issues surrounding community involvement seriously. If they were unable to confirm that they have a policy in place for this, they were asked to provide further information.

xx. Do you have a policy outlining your commitment to the local community?

- a. Yes
- b. No {Please provide details of corrective actions and timings}

Supply Chain CSR: This section of the questionnaire asked the respondents to confirm how the supplier managed their own supply chain CSR assessments and monitoring. They were asked to reply to whether they had a company policy in place and to define the practical means by which they do this work.

xxi. Do you have a policy for CSR in your supply chain?

- a. Yes
- b. No {Please provide details of corrective actions and timings}

xxii. How do you monitor your supplier's CSR performance?

- a. Audits
- b. Periodical retraining
- c. One-off induction training
- d. Verbal communication
- e. Questionnaires
- f. current activity, but plan to
- g. No current activity, no plan to
- h. Other
- i. {If No current activity, but plan to, how do you monitor your supplier's CSR performance? Please provide details of corrective actions and timings}
- j. {If No current activity, no plan to, how do you monitor your supplier's CSR performance? Please provide details of corrective actions and timings}

Comments and Further Information: The final section of the questionnaire provided the respondent with the opportunity to give further details that could be taken into consideration or would support their answers in the evaluation stage.

xxiii. Please add any other information you feel relevant and/or highlight areas where you may need additional support.

Deployment: The questionnaire was sent to suppliers for completion within a predefined timeframe. The initial plan was to conduct questioning process remotely and via the web. However, a number of participants reported problems in completing the questionnaire online and were instead sent a soft copy of the questionnaire in spreadsheet format and where requested a hard copy.

Supplier engagement, monitoring of submissions, and chasing: A new email account was set up for this specific purpose. The purchasing manager and the buyers in the department were given access to this address to monitor the progress and use any information they might need in related activities (Appendix B)

A tracking sheet was designed using a spreadsheet to monitor which suppliers had completed their questionnaire submissions and which were yet to do so (Figure 6-9). This tracking sheet was placed on the company network and allowed buyers as well as the author to update it with problems and questions raised during the process.

	A	B	C	D	E	F	G	H	I
	Company	Original Contact	Original Contact	New Contact	New Contact Email	Completed Questionnaire	Sent Chase Email	Sent Hard Copy	Notes
1									
2	Supplier 1	###	###			x			
3	Supplier 2	###	###			x			
4	Supplier 3	###	###			x			
5	Supplier 4	###	###			x			
6	Supplier 5	###	###			x			
7	Supplier 6	###	###			x	x		Contacted their head office in ### 11.02.08 asked to complete online by 01.03.08
8	Supplier 7	###	###			x			
9	Supplier 8	###	###			x			
10	Supplier 9	###	###			x			
11	Supplier 10	###	###			x			
12	Supplier 11	###	###			x	x		Will complete over the weekend.
13	Supplier 12	###	###			x	x		Need to send in normal email format.
14	Supplier 13	###	###			x	x		Said they would reply by 31.01.08, haven't done so yet. Alternative contact ###
15	Supplier 14	###	###	###	###	x	x	x	### has taken charge of this issue. Would like questions in Excel format.
16	Supplier 15	###	###			x	x	x	
17	Supplier 16	###	###				x	x	Couldn't follow the link. Send normal email (and attachment). Copy ###.
18	Supplier 17	###	###				x		
19	Supplier 18	###	###				x		
20	Supplier 19	###	###				x	x	Couldn't follow the link. Send normal email (and attachment)
21	Supplier 20	###	###				x		

Figure 6-9. Supplier submission tracking sheet

Evaluation: The responses from the participant suppliers were evaluated and scored to identify suppliers to be considered for future CSR audits. The process of evaluation was carried out using a tool developed by the author (discussed later in this section), along with help from the purchasing manager and buyers in the sponsor company.

Scoring: The first stage in evaluating each supplier response was to score the responses. The process developed for this was to award a point for each positive answer received from the supplier. For example, the yes/no questions of each section would receive a point where the supplier indicated a competency and no point where it did not.

This process was largely automated using the tool developed for the evaluation. However, the analysis of more complex answers of the questionnaire, such as those where a supplier could chose from a predefined list of options and/or offer their own answers was more involved. This required each response to be considered and awarded a point based upon the judgement of the assessor as to whether a supplier had provided an adequate explanation of the company's competency in that area.

Weighting mechanism: The results from each of the five sections of the questionnaire were totalled giving a local score. Each of these scores was then adjusted to arrive at a figure representative of that section's importance to the overall score. The weighting for each of the sections was developed through consultation with the purchasing manager, and was informed by the literature review.

The weighting of each of the section is shown in Table 6-2.

Table 6-2. Weighting of questionnaire sections

Section	Weighting
General	0.1
Workforce	0.4
Environment	0.4
Community	0.2
Supplychain	0.3

This weighting mechanism was adjustable by altering the details of the summary sheet in the evaluation tool.

Competency calculation and grading: The scoring and weighting processes allowed for the final stage of evaluation to be carried out. This stage was to take each of the local scores for the

questionnaire sections and calculate an overall CSR competency score for each of the participating suppliers.

The maximum and actual score for each section were used to evaluate how competent each supplier was in that area. This competency was expressed as both a numerical score coded in red/amber/green, and on a three point scale similar to that used in the sponsor company O/Δ/X. An actual score below 1/3 of the maximum available score received X, an actual score between 1/3 and 2/3 of the maximum available received Δ, and finally an actual score above 2/3 of the maximum available received O.

Tool development and usage: The results of the questionnaire were brought from the online system and the hardcopy responses into a single spreadsheet. Each section of the questionnaire was colour coded and separated into individual sheets. A summary sheet was then developed which took the results from each section for each supplier and summarised them in a quantifiable format. Two versions of this summary were produced. The first gave a numerical evaluation for each supplier against each competency. The second gave the results in the three-point format used in the sponsor company (O/Δ/X).

Each section was colour coded, and the local score was shown. The local and total scores for each participants and each section were coloured using a red/amber/green coding to correspond with the supplier's three point scale of assessment.

The summary sheet allowed for both the weighting of each section's importance to the overall score and the grading using red/amber/green and O/Δ/X to be adjusted. The calculations in the summary sheet were linked using formulae to automatically update, and re-grade each response based upon the desired criteria.

The scoring and grading of each supplier's CSR competency indicated whether it was a candidate for audit (Figure 6-10).

	A	B	C	D	E	F	G	H
1			General	Workforce	Environment	Community	Supplychain	Total
2		Weighting	0.1	0.4	0.4	0.2	0.3	1.4
3		Max Score	3	8	8	1	2	7.5
4								
5		Supplier	General	Workforce	Environment	Community	Supplychain	Weighted Score
6		1	3.0	8.0	6.7	1.0	0.0	6.4
7		2	3.0	8.0	7.5	1.0	2.0	7.3
8		3	3.0	8.0	6.2	1.0	2.0	6.8
9		4	3.0	8.0	5.8	1.0	1.0	6.3
10		5	3.0	7.0	6.2	0.0	2.0	6.2
11		6	1.0	3.0	6.0	0.0	0.0	3.7
12		7	2.5	8.0	6.2	0.0	0.0	5.9
13		8	3.0	8.0	7.9	0.5	2.0	7.4
14		9	2.0	8.0	6.1	0.0	1.0	6.1
15		10	3.0	8.0	2.7	1.0	0.0	4.8
16		11	3.0	8.0	6.9	1.0	1.5	6.9
17		12	3.0	8.0	7.3	1.0	2.0	7.2
18		13	3.0	8.0	6.6	1.0	2.0	6.9
19		14	3.0	7.0	6.9	1.0	0.0	6.1
20		15	0.0	0.0	0.8	0.0	0.0	0.3
21		Average	2.6	7.0	6.0	0.6	1.0	5.9
22								
23		Supplier	General	Workforce	Environment	Community	Supplychain	Grade
24		1	O	O	O	O	X	O
25		2	O	O	O	O	O	O
26		3	O	O	O	O	O	O
27		4	O	O	O	O	Δ	O
28		5	O	O	O	X	O	O
29		6	Δ	Δ	O	X	X	Δ
30		7	O	O	O	X	X	O
31		8	O	O	O	Δ	O	O
32		9	O	O	O	X	Δ	O
33		10	O	O	Δ	O	X	Δ
34		11	O	O	O	O	O	O
35		12	O	O	O	O	O	O
36		13	O	O	O	O	O	O
37		14	O	O	O	O	X	O
38		15	X	X	X	X	X	X
39		Average	O	O	O	Δ	Δ	O
40								
41								
42		Setup	O	Δ	X			
43		High	1	0.66	0.33			
44		Low	0.67	0.34	0			
45								

Figure 6-10. Supplier evaluation tool

Why it was done in this way

The Questionnaire: It was understood from the outset that the questionnaire would have to be developed with close consideration to the context in which it was to be delivered. The issues discussed earlier in chapter have outlined some of the key research constraints that influenced the format and overall design of the questionnaire. In addition to those practical restrictions, accepted good design practices were observed.

Poorly designed questionnaires can deter otherwise willing participants from completing their responses (Robson, 2002). An overly long or complex CSR questionnaire would likely result in fewer responses (Robson, 2002). Keeping candidates informed of progress and designing succinct and well structured questions meant that the process successfully converted the majority of the candidates issued with the questionnaire into respondents.

Using a questionnaire developed and deployed online allowed for a quicker dissemination of questionnaires as well as responses. It also allowed the author to include tracking information which showed which respondents had viewed, attempted, and completed the questionnaire at any given point in the process. This was useful in chasing up responses and offering help to any respondent who might be facing technical difficulties. Using tracking data also made the process of evaluation much more straight forward as it removed the possibility of missing responses.

Using an online questionnaire also made it possible for respondents to resubmit their responses quickly and simply during the evaluation process. This opportunity was utilised by several of the suppliers as more information became available to them.

Development of sections, questions, and response options: The five sections were used to group together questions in the questionnaire because they reflect the major CSR competency areas identified both from the literature and through conversations with the purchasing manager.

The design of the questions was intended to make the process of completing the questionnaire as straight forward as possible for the respondents, whilst also ensuring that sufficient data on their CSR competencies could be gathered. Using a large number of yes/no questions along with lists made this possible. It also made the process of evaluation possible because it removed much of the textual analysis that would otherwise have been necessary if more of the questions had been free text responses. Options were also given for the respondents to provide additional information which ensured that the evaluation process would not suffer from being over rigid.

Supplier engagement, monitoring of submissions, and chasing: A critical element of the management of the study was to engage the participant companies and encourage them to become active contributors. The companies were undoubtedly under time pressure from critical business needs and understandably so this questionnaire could have been overlooked. To gain their buy-in, three official communications were sent out using the sponsor company's email system. Using a university email address may not have been as productive as it would not have had the same pull factor as using a sponsor company address.

This setup allowed a single point of contact and prevented information from being dispersed and lost. Without a specific deadline it was questionable whether a sufficient response rate could be achieved within the time constraints of this research.

The deadline was extended to encourage the maximum number of responses. Initial communication had happened towards the end of the calendar year and so over the holiday period there was the risk that the questionnaire might be pushed to the back of people's minds.

A structured and well documented engagement policy was critical in tracking and chasing responses. The most difficult element of the evaluation process was to move from the confines of the sponsor company and communicate with external participants with whom little or no personal relationship was present. There were numerous difficulties that arise when conducting a process such as the one described in this chapter.

Securing a reasonable response rate from a survey is a substantial issue and critical to the success of this study. In order to meet this challenge the process had paid close attention to preparatory conversations and interactions between the participants and the interviewer and has also used strictly well designed questions that do not deter the participants.

Evaluation: The evaluation process had to be designed in a way that would make it both robust and possible for the employees of the sponsor company to be able to implement future iterations in a seamless manner. These requirements were at conflict with one another and suggest different design philosophies. At the extreme, the most robust evaluation mechanism would require a large investment of time. At the opposite extreme a process which can be implemented and managed without any impact on resources would be unlikely to produce meaningful results. Therefore the evaluation process was developed to reach a balance between these criteria.

Scoring: The scoring of questions was kept to a simple points awarding system. Firstly, it gives a clear indication of whether a competency had been identified. Where there was any doubt or insufficient information, there were no points awarded. Secondly, it makes it relatively straightforward to use the figures in automated calculations without the need to make complicated adjustments, making the scoring process simpler to understand for the users and easier to adjust in the future. It was necessary to use the judgment of purchasers in the department for some of the responses. While this made the process longer than a fully automated approach, it also made the results more robust and therefore more useful. In requiring purchasers to consider some of the respondents answers to questions (number of choices from lists, and free text supplementary information) it was possible to more accurately

judge the competency of a supplier in key areas of CSR policy and application. The number of questions requiring human input in assessment was kept to a minimum for reasons discussed above, but the author felt that in particular areas of importance it was appropriate that greater latitude be offered to respondents in order to make the process fairer and less prescriptive.

Weighting mechanism: The weighting mechanism was established so that the local results from each section of the questionnaire could be combined to establish a final and total evaluation of each supplier. Each of the five sections sought to investigate different aspects of the suppliers' competencies. However, not all of these competencies are of equal importance to the sponsor company and other similar manufacturers. In addition, the relative importance of each area of competency categories in the sections is subject to change. These changes may occur due to business need, regulation, market trends, or the nature of the business of the suppliers under consideration. For these reasons, it was important to allow the users of the evaluation tool to readjust the scoring of responses in line with these needs. To do this, an area in the spreadsheet contains setup figures which are used to transform the scores of each section into results which reflect their relative importance to the overall score. Setting aside an area in the tool as a setup table, allows the users to make fine tuning adjustments as and when needed, without the need to carry out additional calculations.

Competency calculation and grading: The grading of supplier competencies was the final stage in the evaluation process and was designed to be as automated and efficient as possible for reasons similar to those already discussed. Using an area in the spreadsheet for setup values of the grading made it possible to adjust the calculations and grading of each section as required. In this case, an even split was given between the three grades, but because the tool includes a setup table, these can be changed at one place and the grading process automatically reflects this change.

Tool development and usage: The evaluation tool was developed to bring the stages of evaluation already described into one place. Using a spreadsheet made it possible to automate large parts of the evaluation process. Developing the tool in this way also made it easier for the users to make adjustments to its functionality without the need for advanced software development skills.

Colour coding the questionnaire sections made the task of assessing the responses clearer and less likely to suffer from human error. The colour coding of the sheets and columns was kept

consistent throughout to ensure that the users could more easily analysis the results of the questionnaire and the evaluation tool.

The summary sheet was developed to give a one page summary of the evaluation process. Using this sheet, the purchasing manager can see how many suppliers have completed the process, how each of the respondents have scored in each of the key CSR competency criteria, how each section is weighted and graded, which suppliers are current candidates for audit, and most crucially why they are the candidates.

The dual scoring and grading system gives the purchasing manager scope to use the results in different ways. Internally, the purchasing manager can communicate the results using the O/ Δ /X and externally the numerical scoring is useful.

6.5 Discussion

This section discusses the results from the case study and what the results of the CSR evaluation meant for the sponsor company.

Participants selection

The participant selection was used in this case as a means of identifying which suppliers should be assessed using the CSR evaluation questionnaire. This was an important component in the overall process because otherwise it would not have been feasible to evaluate the sponsor company's sizeable supply base in full. In this case, the number of suppliers used for evaluation was 20. This figure was negotiated with the purchasing manager. However, the way in which the process and assessment tool was developed allowed for this figure to be easily changed (up to a maximum of 70). Identifying 20 suppliers for evaluation was essential as the attrition rate was unknown and estimated to be sizeable. Any fewer than 20 participants risked invalidating the evaluation process.

CSR evaluation

The CSR evaluation process was used in this case as a means of identifying which suppliers should be considered for CSR audit. This process was significant because it gave the purchasing manager an objective basis for decision making. In this case, 15 out of the 20 suppliers identified for evaluation successfully completed the questionnaire. Within the timescales of the investigation the remaining five were either unable or unwilling to participate.

The CSR evaluation process ran successfully in the winter of 2007 and has since been rerun in 2008 and 2009. The process has been incorporated into the sponsor company's supplier CSR evaluation procedures.

The recommendation of suppliers for audit, produced through this process, was accepted by the sponsor company's senior management.

6.6 Summary

This chapter has presented a major component of the Purchasing Cost and Risk Reduction Methodology, namely the evaluation of supplier CSR competencies to identify suppliers for audit.

The chapter began by defining what CSR means for a modern organisation and the touch points that must be monitored to comply with stakeholder expectations. A brief discussion on the importance of these issues was given with an analysis of the opportunities and threats that the move towards CSR implementation has. The opening section of the chapter concluded by setting out the specific aim and objectives of the CSR study and setting the work in the context of sponsor company's operations. The main body of the chapter presented the CSR study. The study was conducted in two parts. Firstly, the supply base was analysed to identify participants for the evaluation. Secondly, the evaluation was conducted through the use of a questionnaire. The work has been comprised of the stages of problem identification, data mining, practitioner interviews, data analysis, and strategy formulation. Professional buyers were used to help select the test sample. By using their experience it was possible to more accurately identify risk areas and reduce the likelihood of omission. Online questionnaires were used to assess each supplier in the test sample. Using web-based tools allowed for the speedy dissemination and return of results. It also provided administrative assistance in tracking and monitoring responses and completion rates. A system of scoring supplier responses was established to quantify the current position and therefore measure future improvements. The chapter concluded by providing an analysis of the results of this implementation and the consequences this had for the sponsor company.

Chapter 7

Sourcing Study

7.1 Introduction

This chapter explores the process of reducing the purchasing price of Japanese sourced machine spares while maintaining a diverse supplier base and describes the development of a structured approach to doing this. The chapter begins by discussing sourcing and pricing and the issues relating to its management in a modern automotive enterprise. The main body of this chapter presents a structured approach to tackling these issues developed through literature and field research.

7.2 Chapter Structure

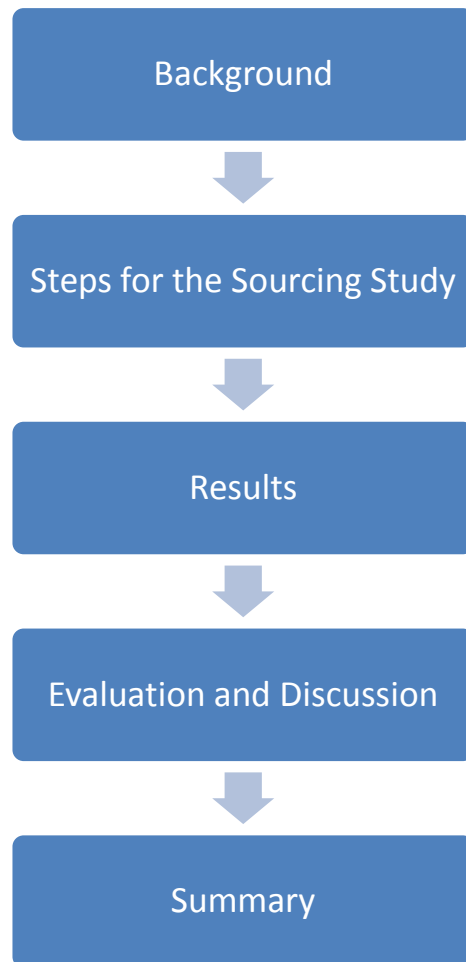


Figure 7-1. Chapter structure

7.3 Background

This section presents sourcing as a subject and explains why its successful implementation is of such importance to manufacturers such as the sponsor company. The purpose of the study is then discussed along with the aim and objectives. Finally, the practical considerations and limitations made by the author before and during the research are described.

Automotive manufacturers have achieved productivity and efficiency improvement by paying particular attention to their operational and production areas. However, many of these production practices no longer offer strategic advantage and today's automotive manufacturers are seeking new ways to improve their overall performance. One business area coming into focus is corporate purchasing. This study has paid particular attention to the purchasing of key consumable parts sourced from the far-east and used in the production of cars. The work shows how structured competitive bids (with virtual baskets of parts) can allow a manufacturer to make cost savings while strengthening its supplier base.

Resourcing occurs when a buyer organisation switches suppliers for the acquisition of inputs. This process can deliver a number of benefits to the buying organisation. Chief amongst these is a lower cost base. Continual resourcing will likely have a detrimental impact on both the buying and selling organisation and therefore manufacturers must be restrained in their use of this approach to negotiating prices. Counter intuitively, resourcing can also be beneficial to supplier organisations. Suppliers who can demonstrate that they meet continuous improvement targets, and work to find areas of cost reduction during these periods of negotiations can win new business and broaden their customer base.

The purpose of this study

Manufacturing organisations that produce high-value products using complex components sourced globally face a number of issues in keeping costs down.

Organisations similar to the sponsor company can achieve substantial and long-term cost reductions by resourcing of parts to local/regional suppliers with whom they can build a strengthened supply relationship. Suppliers, which have a greater knowledge of the manufacturer's business and operations, are better able to identify issues of oversupply. Regional suppliers in the machine spares market use their buying power to hold stocks at a cheaper margin than individual organisations can manage on their own. In addition, they have the technical expertise to understand the inter-changeability of parts. Resourcing to regional suppliers from a traditional far-eastern supply route is not without its drawbacks and difficulties.

There is likely to be an inbuilt reluctance on the part of the parent supplier company to lose business of their subsidiary/regional-division. There may also be agreements in place between the respective parent companies on the amount of business that their regional subsidiaries will provide to one another as part of wider supply agreements. Changes in these terms can have a knock-on impact in this area. Manufacturing organisations, such as the sponsor company, require a structured and repeatable means of reallocating business amongst their current supply base that takes account of the sensitivities and does not unduly harm the viability of their supplier's business model.

The aim of this study was to investigate the formalisation of the sourcing issues discussed in the literature review. Specifically, the study sought to develop a repeatable process to identify the suppliers and parts to be included in the resourcing process and then manage a process of tendering and resourcing to maintain business levels whilst finding cost savings for the sponsor company. The objectives of the study which led to this aim were:

- To identify parts to be included in the resourcing trial.
- To gain buy-in from supplier companies both in Europe and the far-east.
- To produce a repeatable and adaptive process that would be seamlessly integrated into the wider process of a major automotive organisation.

The findings from this study are used to populate the Purchasing Cost and Risk Reduction Methodology (PCRRM) skeleton as presented in Chapter 5 of this thesis. As a major component of the PCRRM, sourcing can be considered to be a feeder process for its peers (Figure 7-2).

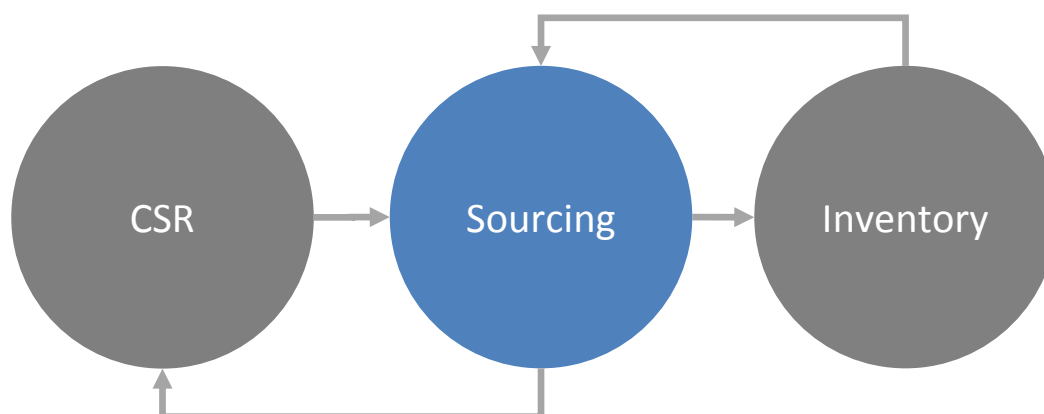


Figure 7-2. Findings of the study as a component of the PCRRM

Practical considerations

The study described in this chapter was conducted in a real world context. There are a number of associated advantages and disadvantages that this form of research can bring, as described in Chapter 4 of this thesis.

It would not have been possible to run the study without the expressed approval of each of the sponsor company's senior management and in particular the approval of the purchasing manager. The sponsor company expressed the view that they wanted to keep the work that their suppliers needed to do in order to participate in the study to a minimum. That is not to say the study should not probe the details but rather it should not be overly protracted and distract from the immediate needs of the business to maintain supply. In addition, they made reference to the fact that if the findings of the study were to be implemented in the company then they should be sympathetic to the needs of a real world operation and not merely be the product of a purely theoretical exercise. Although these requests were not binding on the author it was felt the author that these issues were in fact central to the study in terms of future generalisability and therefore useful considerations should be taken into account. In addition, the author also felt that by designing the study to be sympathetic to these issues, the sourcing component of the PCRRM would be more robust and therefore more easily validated in later stages of the research programme.

The participating companies were known to be large geographically dispersed, meaning that it was especially important to implement a traceable process which could be managed remotely where necessary.

The participating companies were suppliers of Japanese origin/specification machine spares. The companies had European subsidiaries or hubs that could supply these parts. However, for historical reasons the supply of Japanese origin/specification parts was being dealt with by the Japanese based offices. This meant that although the sponsor company had a working relationship with the European divisions of these suppliers, their contacts were not necessarily overseeing all supplies from their organisation. This meant that the process needed to give the supplier companies as much information about the parts as possible to allow them to make accurate tenders for the business. The process was designed to be thorough but not overly burdensome.

The key actors were identified as being:

- Purchasing Manager – Overseeing the process in the sponsor company.

- Buyers – Senior members of the purchasing team in the sponsor company who could draw upon personal experience and sponsor company policy documents to help the study move forward.
- Suppliers – The source of inputs for the sponsor company that would be included in the study. Typically of similar status to buyers.
- The author – The designer and implementer of the study

7.4 Steps for the Sourcing Study

This section presents the three phases of the resourcing study. Each is discussed in terms of their aim, method of development and implementation, and rationale. All steps of the investigation were conducted in the field under the supervision of both the academic and industrial supervisors.

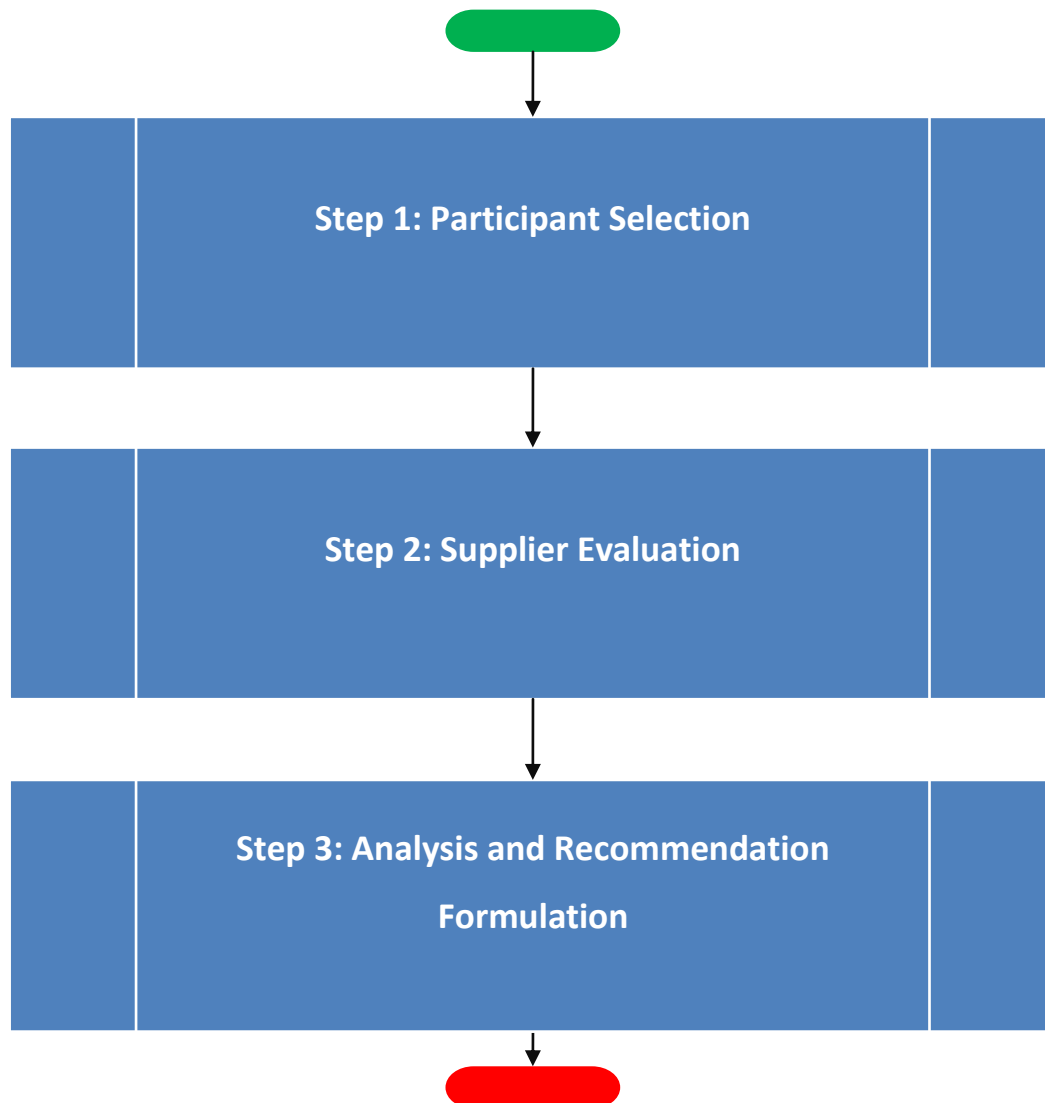


Figure 7-3. Steps for conducting the Sourcing study

Step 1: Preliminary Investigation into Price Differences

Aim of this step

The purpose of this step was to investigate and analyse the price/cost difference between Japanese and UK machine spares prices. This was needed to provide a weight of evidence that this issue was real and an area open for improvement in order to secure resources. The nature of this work was politically sensitive within the organisation, so the setup of this study required evidence – facts and figures – to support claims and recommendations.

The objectives of this step were therefore to:

- Identify a sample of parts
- Match them to parts used in Japan

- Uncover and report purchase price differences

How it was done

The first step in the process was to identify a suitable sample of Japanese origin machine spares to compare. These parts would be used to compare prices between the UK and Japan. This was done in two parts: firstly the database was consulted to identify parts with a manufacturer field containing a known Japanese manufacturer; secondly the Purchasing Manager was interviewed to refine and add to this list based on his/her experience. The parts were selected based on their suspected usage in both regions.

The next step in the process was to pass this list onto a courier to be taken to Japan. The political sensitivities of this type of investigation meant that it was not possible to conduct this initial investigation through normal business channels. Instead, the courier agreed to take the list to a contact in a Japanese plant to record the prices being paid at those facilities. The contact in Japan used a combination of internal specification, manufacturer specification, and manufacturer detail to match the parts between the UK and Japanese systems. The courier was an employee of one of the sponsor company's European plants. On his/her return, from Japan the courier delivered the completed price list.

The final step was to convert the prices into the same currency (both Yen and Sterling for reporting to different internal audiences) and then compared on a like for like basis. This comparison was graphed and presented to the Purchasing Manager and other senior managers in the sponsor company.

Figure 7-4 shows the main stages in conducting the preliminary price investigation process.

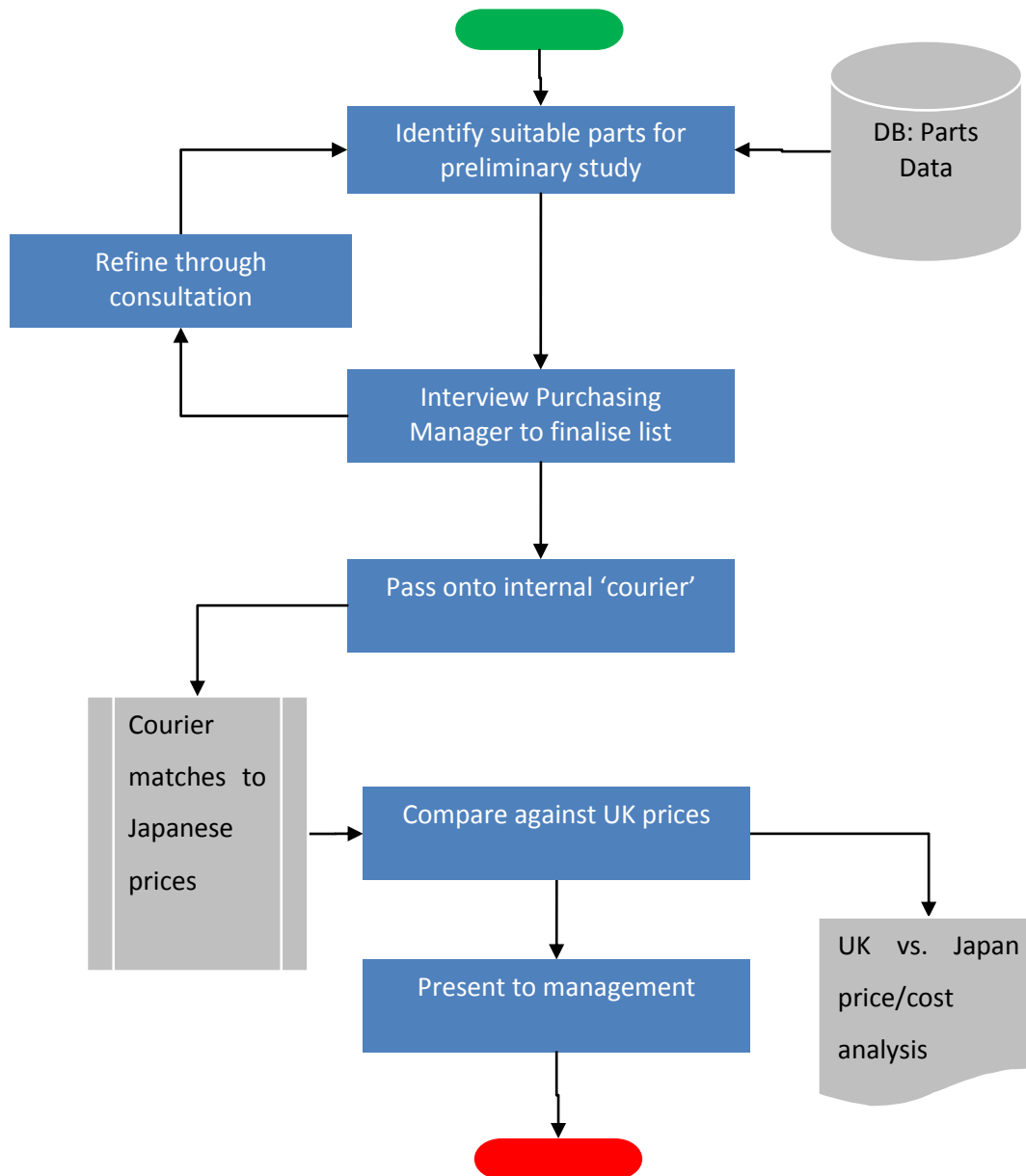


Figure 7-4. Preliminary price investigation process

Why it was done in this way

The parts chosen for the investigation were selected because of their likelihood of being used in both regions. They were identified in a two phased approach to increase this likelihood. The production facilities across the sponsor company are broadly comparable in that they use many of the same machines and therefore many of the same parts. However, specific differences do occur due to time of installation, the specialisation of the facility, age of the machinery, and purchasing behaviour particular to the plant. With this in mind, it was prudent to interview the Purchasing Manager to identify parts from the initial data extraction that would most likely be used in the Japanese facility.

Using the manufacturer data as a basis made it possible to compare like to like parts without requiring the detailed technical knowledge upfront that would have been needed to compare across parts categorised as equivalents.

A necessary component of this study was the delivery of the parts list to a technical expert in Japan. This element of the study was necessary for two reasons. First and foremost, the technical knowledge to identify parts as matching /equivalents did not exist in the UK based division or with the author. The specifications used in machine spares classifications is highly specialised requiring a deep knowledge. It was known prior to this study that some part specifications are altered prior to their entry in the sponsor company's system making cross-checking particularly challenging. These alterations can happen for a variety of reasons including translation errors between Japanese and English technical nomenclature, user entry errors, deliberate alterations on the part of intermediate suppliers or manufacturers, and regional naming conventions/standards. Secondly, it was not possible to access this data remotely as the internal systems did not permit this operation. Additionally, the political sensitivities of this study meant that the preliminary investigation needed to remain relatively quiet until the facts were gathered to support future work. Using a courier for the investigation made it possible to conduct the investigation with minimal interference of outside parties.

The analysis was structured to make it easy to reference and understandable to a wide audience to give maximum impact and secure the resources to conduct the rest of the study. Although these arguments had been in circulation for some months, it was not until the data and analysis were presented to senior management as part of the preliminary investigation that they were able to action further investigation.

Step 2: Trial Setup and Implementation

Aim of this step

The purpose of the trial setup phase was to establish the basis of the trial in terms of data requirements, suppliers to be included in the work, the parts that they would consider, the establishment of a reliable and repeatable process framework and the final means of assessment.

The setup used raw data from the information system and delivered it to the suppliers in a usable and consistent format. It was important to the overall process that communication with the suppliers as to the reasoning and objectives of this study be carried out in a timely and responsible manner. The setup phase therefore took account of supplier needs by including them in the process design. The objectives of this step were therefore to:

- Identify the parts to be considered in the trial
- Identify the suppliers who could tender for this business
- Arrange a supplier conference to discuss the need for this work
- Agree a process framework with timings
- Disseminate all the data the suppliers would need to conduct the tenders

How it was done

The most significant Japan parts, manufacturers and suppliers were identified from the sponsor company database using Pareto analysis. The usage and price were used to calculate the most recent spend over a 12 month period.

This process retrieved 96 machine spare numbers which were suitable to include in the trial. Using this data, the manufacturers of these parts were identified from the database. It was necessary to cleanse this data as the sponsor company's system had allowed free text inputs which included multiple mistakes.

The next step was to identify potential suppliers for these parts to be included in the trial. This was carried out in two steps. Firstly, the supplier data on the information system gave the current supplier for each part line by line. Secondly, the Purchasing Manager and buyers in the purchasing function were interviewed to identify historic and/or potential supplier for these parts. Using this the author negotiated a consensus between the Purchasing Manager and a Senior Buyer as to which suppliers were to be included. The final count was six large suppliers with European subsidiaries.

Following the initial data retrieval and settlement on which suppliers to involve, the author asked the buyers in the department to contact their equivalents at each supplier and give them an initial presentation of the purpose of the work. The Purchasing Manager also discussed the intentions of the process with her contacts at senior levels within the supplier companies.

The part details were then used to create two documents. The first was for internal usage to be seen by only members of the sponsor company and the author. This file contained all the part details along with sensitive information including the current supplier, precise usage per year, and current price being paid. The second document was for external usage, to be seen by all participants and used by the suppliers in their investigations and tendering. This file did not contain any the sensitive information held within the internal file (Table 7-1).

Table 7-1. Comparison of data used in setup and implementation: internal vs. external

Internal Data Points	External Data Points
• Part Number • Supplier Code • Supplier • Currency • Site • Current Price • Lead Time • Manufacturer • Manufacturer Part Number • Issue Quantity • Rank by Value • Rank by Quantity • Exchange Rate • Converted Price • Current Spend	• Part Number • Currency • Site • Lead Time • Manufacturer • Manufacturer Part Num • Rank by Value • Rank by Quantity

The suppliers were then invited onto the site to be given a formal presentation of the trial and provided with the part data. They were informed of the rules for their participation, which were namely that they should attempt tender for as many parts as possible, and that they should maintain the structure of the part files as disseminated to them. It was explained to the suppliers that this process was intended to be a cost saving activity that maintained sufficient business with them while improving the position of the sponsor company. The suppliers were given one month to return their tenders.

The suppliers returned their results, with minimal chasing required, to be analysed in the final phase of the study.

Figure 7-5 shows the main stages in conducting the study setup and implementation.

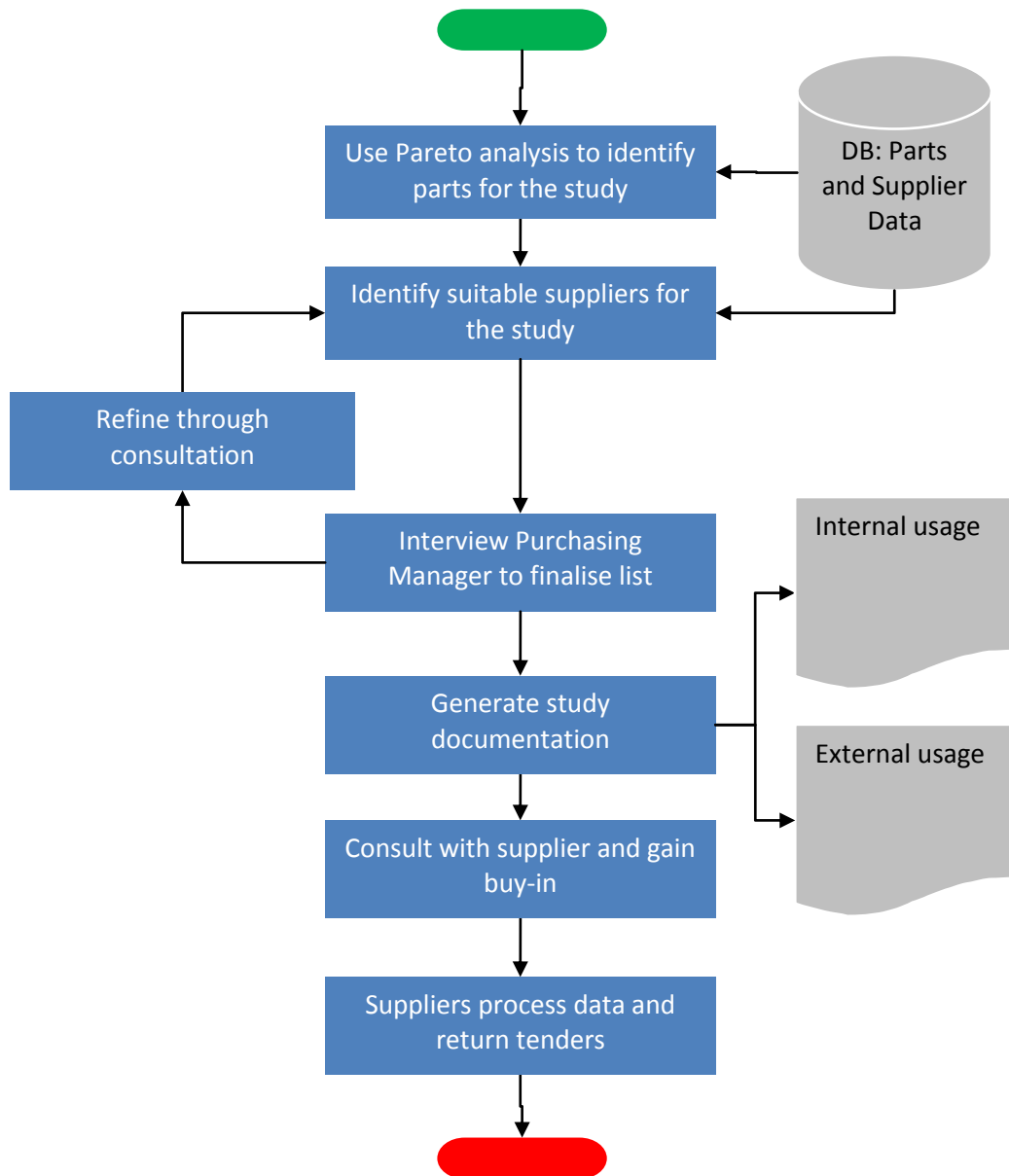


Figure 7-5. Study setup and implementation

Why it was done in this way

The parts were selected for this study initially through the use of the manufacturer field. Although this method caused some initial problems due to numerous data irregularities, it was the most efficient means of identifying Japanese origin/specification parts given the available data. This was a more direct means than comparing supplier data because although supplier's can be identified as Japanese specialists, there may have been important parts not currently supplied by those organisations missed from the study. Likewise, using the part data alone would not have been appropriate because the author and the purchasing department lacked the technical knowledge to accurately identify Japanese specification parts. In this way, there was no

need for any specialist knowledge and the process could be re-run in future iterations with relative ease.

To identify the key parts to be used in this trial and a Pareto analysis was carried out. This analysis considered parts price and its estimated usage (based on previous 12 months) and gave an overall assessment as to the value of this part to sponsor company and the supplier's business. Using the previous 12 months as an assessment basis was settled upon as a broadly accurate estimate of likely usage. However, the nature of machine spares usage is largely unpredictable and therefore previous usage may not reflect future usage. Machines are updated and parts replaced, the wear and failure rates of these parts were unknown to the author and therefore unpredictable. It could be argued that the most recent purchases of parts are amongst the least likely to be repurchased as they have only recently been replaced. In considering the way forward, the author tried to reach a practical compromise. It would not be appropriate for the purchasing department to conduct detailed estimations in future iterations as this would be largely an overuse of resources. What was necessary in this trial was to establish a reasonable basis for inclusion/exclusion.

The supplier companies were included in discussions about the process as early as possible. This was important for a number of reasons. Firstly, it was the ethical way forward in terms of ensuring an open and productive relationship with them. The author and the sponsoring organisation felt that the supplier companies should not feel that they were at the mercy of this process but rather partners in the process. In that way it was easier to promote trust in the process and gain their buy-in and full cooperation. The suppliers are the key elements in this study, without their technical analysis and tendering there could be no cost saving for the sponsor company. Therefore the suppliers were kept up to date throughout the study from design through to implementation.

The study was described to the suppliers as an opportunity to sustain current business levels in the difficult economic climate and to potentially gain new business. This was done to encourage the suppliers to tender for as much of the parts list as possible, thereby making the process more accurate.

The suppliers were delivered a censored version of the parts list. This was done to ensure that the current supplier of those parts could not easily be identified and that the current mark-up on those parts was not known. Allowing the suppliers to view current pricing would have seriously undermined the process and invalidated the results. The suppliers were presented with as much

technical information about the parts as possible in order to make their job of tendering as easy as possible. The suppliers were asked to maintain the formatting of the document in order to ensure that the author and the sponsoring organisation could easily use their tenders.

Step 3: Analysis and Recommendation Formulation

Aim of this step

The purpose of the analysis and recommendation formulation phase was to bring together the tenders submitted by the suppliers and produce a recommendation on resourcing for the Purchasing Manager to implement in the sponsor company. This phase of the study used the suppliers' tenders to calculate the optimal resourcing strategy against both cost and ethical purchasing practices. The process developed in this phase needed to be designed in a manner that would limit the period of time needed to process the results and deliver the analysis to the sponsor company. The process needed to be as automated as possible and not require an in depth understanding of the underlying data. The objectives of this step were therefore to:

- Assimilate supplier tenders into one usable document
- Define savings from each supplier
- Automate the process of calculation and analysis
- Deliver a resourcing recommendation based on cost and ethics

How it was done

Nb. S = a supplier, M = a manufacturer

Figure 7-6 shows the main stages in conducting the analysis.

The first step in analysing the supplier tenders was to pull them into a single point of reference. To do this, a template was developed as shown in Table 7-2. For each of the suppliers' quotations, any irrelevant information was stripped out from the returned files, leaving only the response (the quoted price), the quoted lead time, the current value, and the new value.

Next, the prices quoted by the suppliers were converted into Sterling using an annual average on Yen/Sterling rates agreed between the author and the sponsor company.

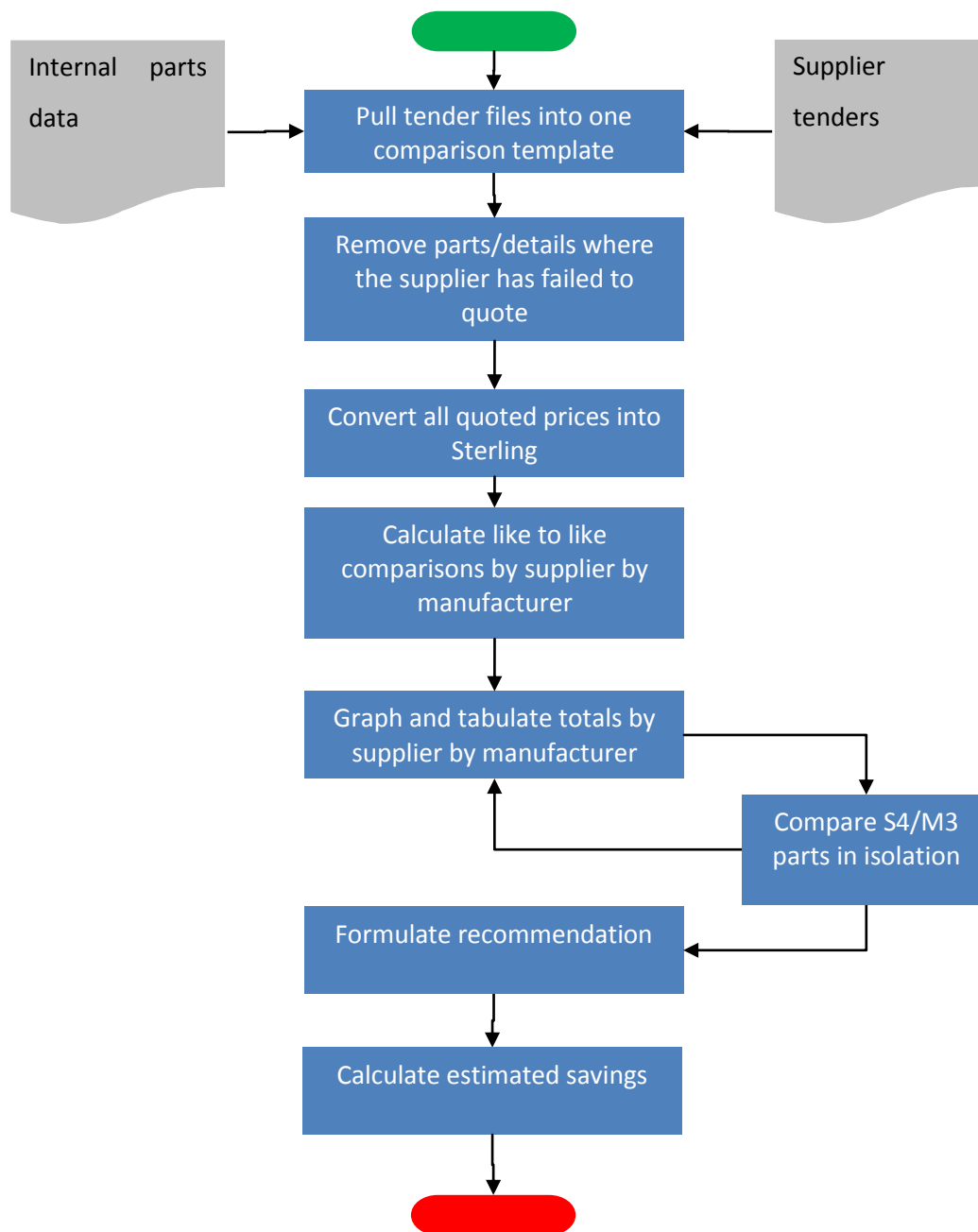


Figure 7-6. Analysis and recommendation formulation

Table 7-2. Resourcing comparison

Base Data	Quotes and Calculations
Part Number	Supplier Response
Supl Cd	Lead Time
Supplier	Original Basket
Currency	Supplier Basket
Site	
Current Price	
Lead Time	
Manufacturer	
Manuf Part Num	
Issue Quantity	
Rank by Value	
Rank by Qty	
Exchange Rate	
Converted Price	
Current Spend	

With the converted quotations populating the template the results were graphed and tabulated to be analysed at the macro-level. The first series of graphs produced shown in Figure 7-7 to Figure 7-12. These graphs were generated by totalling only the values for parts quoted for and splitting these results by manufacturer. This information was summarised in table form as shown in Figure 7-13. The supplier and manufacturer labels were colour coded throughout this and all subsequent tables and figures.

The next step in the analysis of the results was to calculate savings from the supplier tender, positive figures denoting a saving and negative figures denoting an increase in costs.

Why it was done in this way

Nb. S = a supplier, M = a manufacturer

The supplier tenders were consolidated at a single point for easier calculation and cross-referencing. This made the task of comparison straight forward and displayed the missing pieces of the submissions on a single worksheet.

The prices were converted into Sterling using an agreed conversation rate. Within the sponsor company, there exist several conversion rates dependent upon the part in question, the supplier company, and any historical agreements between the two parties. It was necessary though to align all tenders in a fair manner that made it clear what the final quotation was for each part. If this had not been carried out, the analysis and recommendations would have been built on moving targets, dependent upon exchange rate movements.

The graphing of the quotations was carried out to visually demonstrate the positive and negative outcomes from the quotations process. The graphs show that significant areas of the quotation process were overlooked by suppliers, resulting in no data, and limited comparison. In contrast, other areas received a lot of attention from all or the majority of the participating suppliers, providing multiple comparison points for the analysis and recommendation formulation.

The table summaries were used to give the Purchasing Manager an executive summary of the findings of the trial and show where possible savings may be achievable. The colour coding of the graphs and tables was kept consistent to improve the readability and accessibility of the data and analysis.

Parts from S5/M3 were given further consideration because they had been particularly well quoted for. The majority of parts had been quoted for by 4 of the 6 suppliers (Figure 7-15). This additional table was included in the executive summary to highlight and draw attention to this. In the first series of analysis 'virtual baskets' were used. These operated by comparing whichever parts a supplier quoted with historical costs for those parts. Conducting the analysis in this way made it possible to give a fair assessment of a supplier's general cost reduction across manufacturer parts despite there being differences in the combinations of parts being quoted for. These additional iterations of analysis however conducted the comparison on a part for part, like for like basis. That is, they only considered parts where all suppliers had quoted. There were no 'virtual baskets' and no approximations. For this reason S5/M3 vs. M6 were considered separately because S6 had quoted for a far smaller proportion of parts from M3 than the other suppliers. Conducting this analysis enriched the process and gave further perspectives on the underlying data and thus enhanced the recommendations based upon in it.

The final steps in this phase were to generate a proposal for resourcing and provide an estimate for the cost savings that this proposal would generate. The final proposal is given in Figure 7-17. As the figure shows parts from three of the manufacturers can be resourced to a supplier leading to an overall saving. Parts from M1 and M5 however can be resourced with an overall increase in

cost. The rationale for this recommendation is that at the macro-level the sponsor company is set to appreciate an overall reduction in costs. At the micro-level through it demonstrates that the sponsor company is willing to redistribute business to compensate for losses in other areas. In this trial S3 was a particularly prominent supplier across the board of manufacturer parts. In having many of their parts resourced it could be argued that they would be reluctant to participate again in the future due to loss of business. However, the recommendation outlined here provides some compensation for loss of business in one area, with increased business in another. It also demonstrates to that supplier that the process was a serious one, and that for future iterations they might look to offer a greater incentive to maintain their current business. The recommendation to resource to S6 and S5/M3 demonstrates to these suppliers that their hard work in finding cost savings has paid off and that this process rewards commitment from suppliers. For the rest, the recommendation shows that greater attention must be paid in the future and more effort made to quote for as many as possible of the parts available for tender.

The final stage of the process was to estimate the cost savings projected over a one year period based on historic usage of the parts analysed and resourced. This was carried out to allow management to see that the process was set to deliver significant real savings. Even given this more ethical approach to resourcing, the process demonstrated its strength in delivering a substantial overall saving.

7.5 Results

S5/M3 parts were then analysed in more detail. Two comparison tables were produced which isolated S5/M3 parts out from the overall analysis. The format of the comparison tables were consistent with previous tables. The first table (Figure 7-15) was produced to compare S5/M3 as a supplier of its own parts against S2, S3, and S4. The second table (Figure 7-16) was produced to compare S5/M3 as a supplier of its own parts against S6 only.

At the end of this financial analysis, it was possible to formulate a recommendation and calculate the impact on the sponsor company's costs based on the resourcing of parts to different combinations of suppliers.

Figure 7-7 to Figure 7-12 shows the results of quotations. Grouped by manufacturer, these graphs show for the parts that the supplier quoted for, the current cost of the parts, against their quotation.

Figure 7-17 shows the balanced proposal settled upon by the author as an equitable compromise between cost savings and cost increases.

Figure 7-18 shows the cost savings based on estimated business based on the recommendation and contrasts this against the alternative of accepting only overall cost reductions.

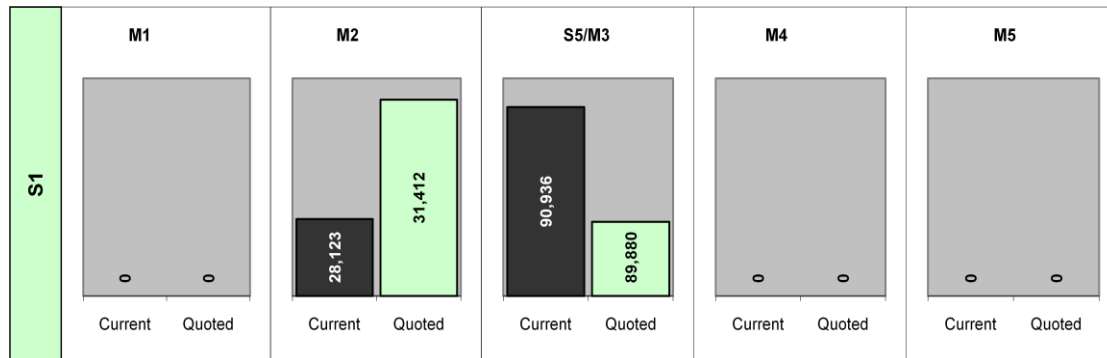


Figure 7-7. Graphed results from Supplier 1

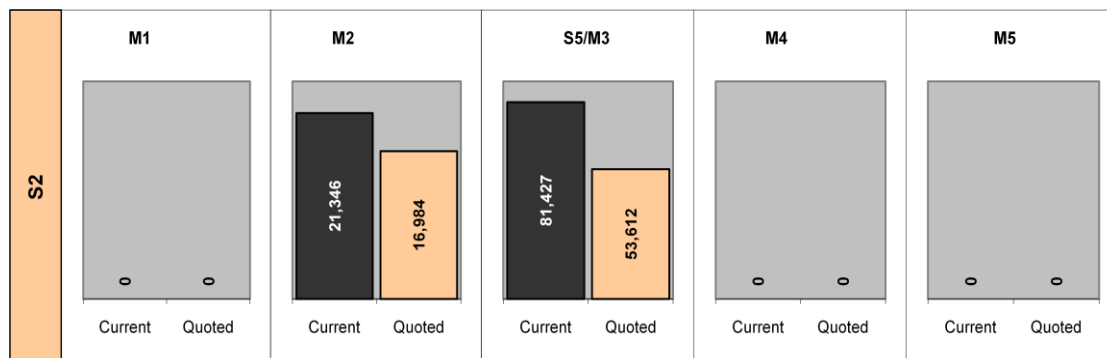


Figure 7-8. Graphed results from Supplier 2

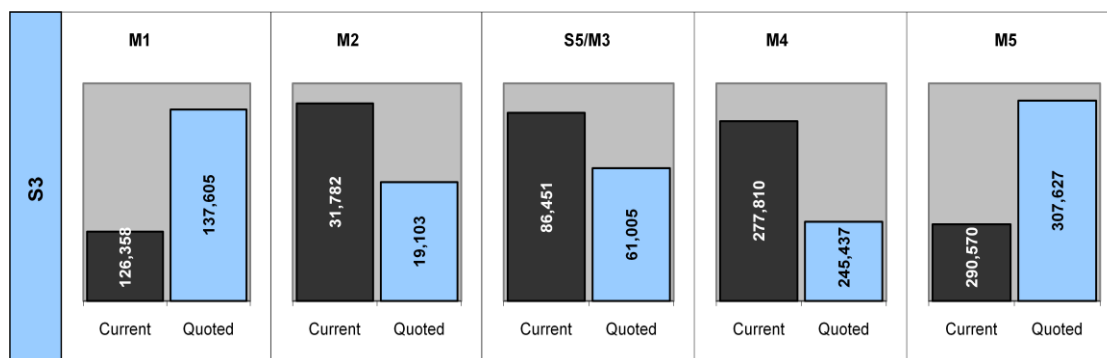


Figure 7-9. Graphed results from Supplier 3

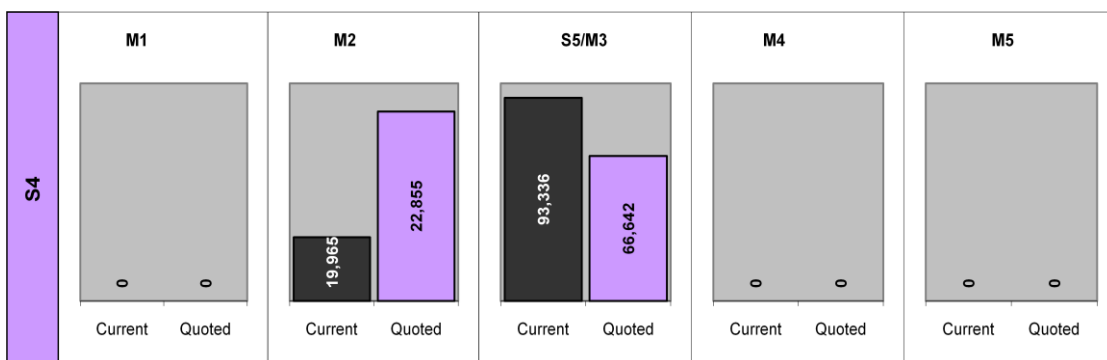


Figure 7-10. Graphed results from Supplier 4

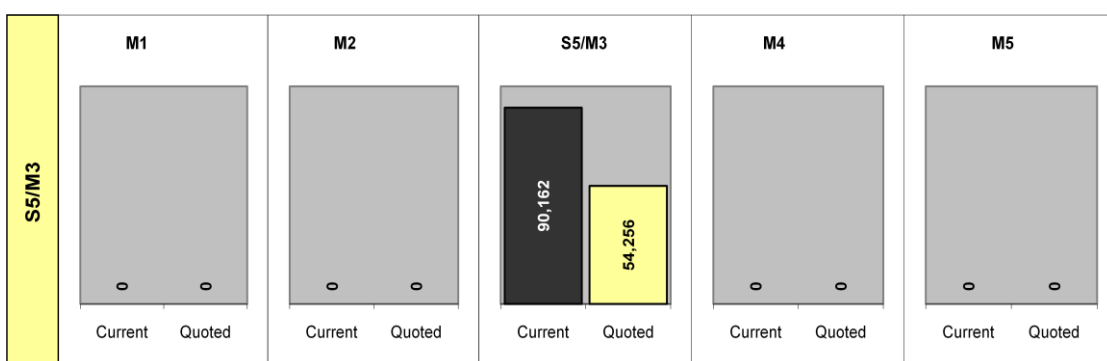


Figure 7-11 Graphed results from Supplier 5 / Manufacturer 3

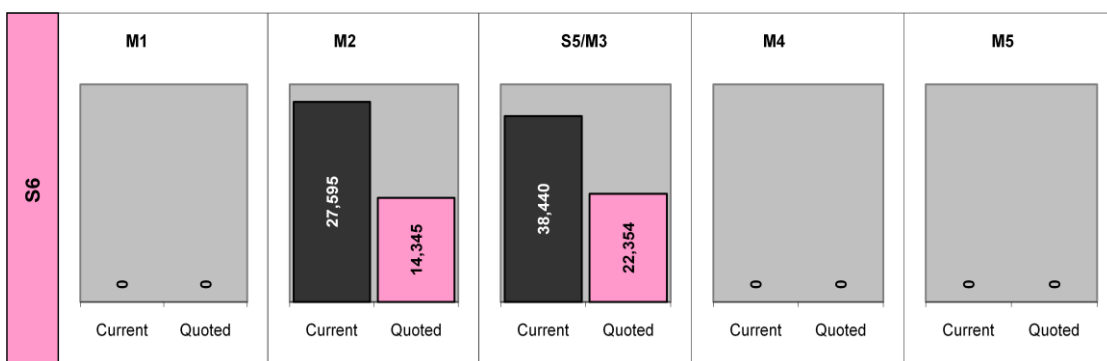


Figure 7-12. Graphed results from Supplier 6

	M1			M2			SC/M3			M4			M5		
Supplier Quotes for Each Manufacturer	Current	Quoted	% Saving	Current	Quoted	% Saving	Current	Quoted	% Saving	Current	Quoted	% Saving	Current	Quoted	% Saving
\$1	0	0	0	28,123	31,412	-11.7	90,936	89,800	1.2	0	0	0	0	0	0
\$2	0	0	0	21,346	16,984	20.4	81,427	53,612	34.2	0	0	0	0	0	0
\$3	126,358	137,605	-8.9	31,782	19,103	39.9	86,451	61,005	29.4	277,810	245,437	11.7	290,570	307,627	-5.9
\$4	0	0	0	19,965	22,855	-14.5	93,336	66,642	28.6	0	0	0	0	0	0
SC/M3	0	0	0	0	0	0	90,162	54,256	39.8	0	0	0	0	0	0
\$6	0	0	0	27,595	14,345	48.0	38,440	22,354	41.8	0	0	0	0	0	0

Figure 7-13. Supplier quotations by manufacturer/supplier

Projected Saving	M1	M2	S5/M3	M4	M5
Current Spend	126,358	47,647	93,336	277,810	290,570
S1	0	-5,572	1,083	0	0
S2	0	9,737	31,883	0	0
S3	-11,247	19,008	27,472	32,373	-17,057
S4	0	-6,899	26,693	0	0
S5/M3	0	0	37,170	0	0
S6	0	22,878	39,058	0	0

Figure 7-14. Projected savings if manufacturer parts are resourced to supplier

Figure 7-13 and Figure 7-14 show the savings in pound sterling of resourcing parts from each manufacturer. Negative value indicate a saving, bold values indicate the chosen resourcing route.

S5/M3Parts - Like for Like	Current	Quoted	% Saving
S2	75,752	49,457	34.7
S3	75,752	54,544	28.0
S4	75,752	53,943	28.8
S5/M3	75,752	45,620	39.8

Figure 7-15. S5/M3 parts only against S2, S3, and S4

S5/M3 Parts - Like for Like	Current	Quoted	% Saving
S5/M3	35,267	20,899	40.7
S6	35,267	20,018	43.2

Figure 7-16. S5/M3 parts only against S6

RE-SOURCE PROPOSAL	M1 Parts to:	M2 Parts to:	S5/M3 Parts to:	M4 Parts to:	M5 Parts to:
	S3	S6	S5/M3	S3	S3
result:	increase	saving	saving	saving	increase

Figure 7-17. Balanced proposal

Figure 7-17 shows the settled option for raking some price increases and some price decreases.

Figure 7-18 shows the difference in savings between taking only price reduction and accepting limited price increases.

Projected Saving in Total	Business Quoted For	Total Savings	% Saving
Take Only Savings	835,721	94,310	11.3
Take Good and Bad	835,721	66,006	7.9

Figure 7-18. Estimated cost savings based on proposal

7.6 Evaluation and Discussion

This section discusses the results from the case study and what the results of the resourcing study meant for the sponsor company.

Japanese parts are substantial input into the sponsor company. The extended supply route for these parts makes them a prime candidate for resourcing activity. In addition, the threshold of data and justification required to progress this programme of work demonstrated how a less disciplined process could have become derailed.

Japanese parts are those sourced from Japanese manufacturers (either directly or through intermediary suppliers) and can be shipped directly from Japan or from regional distribution centres in Europe. Japan parts represent around £1m of spend per year and are therefore a significant contributor to overall expenditure. The comparison of prices paid in the UK compared to those in Japanese domestic market supported this move.

It is logical to conclude that parts sourced from the Fareast are at risk of being marked-up at a higher rate than those sourced from regional distribution centres. Part numbers are easily altered making it difficult for the buying organisation to run fair request for quotation processes.

This effect in combination with the linguistic challenges of investigating these parts make this area fruitful.

None of 6 suppliers selected for the study returned quotes for all the parts requested. The most common reasons they gave for this include not being able to identify the parts, conflicts with management priorities and/or no explanation was given. Given that a simple like for like comparison was not going to be possible, the most accurate means of assessment was to use 'virtual baskets', showing the relative performance for each of the suppliers against current spend.

The research has led to the conclusion that entire business for a manufacturer's parts should be single sourced and reviewed on a 1 to 3 year basis. In addition it was felt fair that short-term cost increases be taken as well the savings. Re-sourcing business to a single competitive supplier will prove advantageous over the medium to long-term. Corporate services will be better able to manage part-supplier-manufacturer relationships. Suppliers will be incentivised to maintain/offer competitive prices in order to retain/gain business. The process of managing price changes will be more transparent and future negotiations for re-sourcing simpler.

It has been recommended that the company take on some cost increases at this stage. There is a real need to demonstrate to suppliers that the company operates in a socially responsible manner and avoiding increases, particularly given the assistance suppliers have offered, would undermine this. Even so, the study has delivered a significant predicted saving on next year's spend for Japanese machine spares of approximately 8%.

The study has demonstrated how using virtual baskets at the competitive bid stage can allow a manufacturer to compare the relative performance of its supply base, even where there is a lack of direct competition on a part by part basis. The cost savings achieved here represent only a small fraction of the annual spend the company invests in new machine spares and consumable goods annually. However, if a similar programme of activities were to be applied across the board, cost savings could run into single digit millions.

The resourcing process ran successfully in the Autumn of 2007 and has since been rerun in 2008 and 2009. The process has been incorporated into the sponsor company's supplier CSR evaluation procedures.

The recommendations of resourcing Japanese origin spares were accepted by the sponsor company's senior management.

7.7 Summary

This chapter has presented a major component of the PCRRM, namely the resourcing of Japanese origin parts to regional suppliers.

The chapter began by introducing sourcing concepts and challenges and the touch points that must be monitored to comply with stakeholder expectations. A brief discussion of the importance of these issues was given with an analysis of the opportunities and threats. The opening section of the chapter concluded by setting out the specific aim and objectives of the study and setting the work in the context of sponsor company's operations. The main body of the chapter presented the resourcing study. The study was conducted in three parts. Firstly, the cost differences between prices paid in the UK and Japan were analysed. Secondly, the data retrieval and trial setup was carried out. Lastly, the returned quotations were analysed and a recommendation made. The work has been comprised of stages of problem identification, data mining, practitioner interviews, data analysis, and strategy formulation. Professional buyers were used to help select the test sample. By using their experience, it was possible to more accurately identify risk areas and reduce the likelihood of omission.

The chapter concluded by providing an analysis of the results of this implementation of the process and the consequences this had for the sponsor company.

Chapter 8

Inventory Study

8.1 Introduction

This chapter explores the process of reducing inventory levels for machine spares and general consumables, while maintaining operational efficiency and cost levels. The chapter begins by introducing the nature of machine spare inventories and the issues related to their management and reduction. The main body of the chapter presents a structured approach to tackling these issues, developed through literature and field research.

Firstly, the conceptualisation of the investigation is discussed. Secondly, a process for selection of a partner is described. The process and results from the execution of the investigation in a live environment are then presented and discussed.

8.2 Chapter Structure

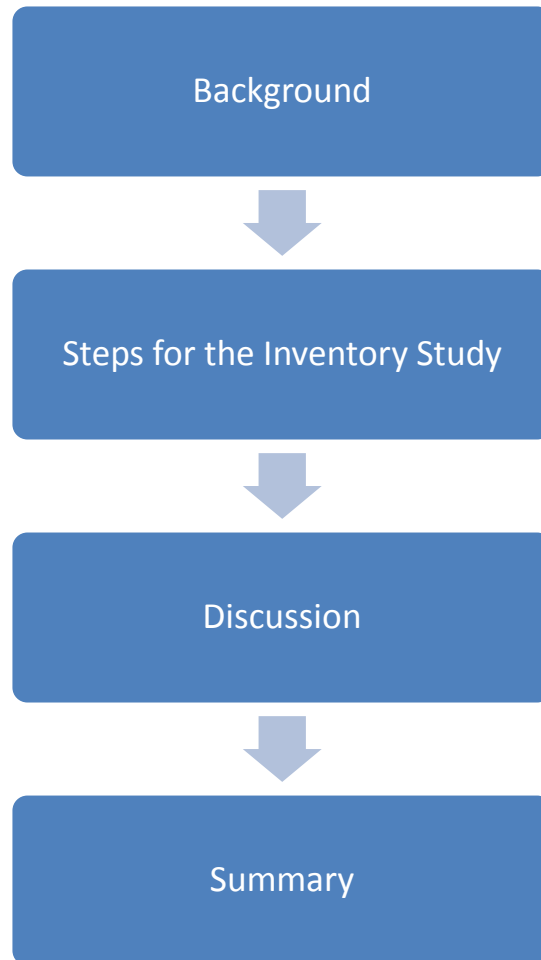


Figure 8-1. Chapter structure

8.3 Background

This section presents inventory management and reduction as a subject and explains why it is of critical importance to automotive and other manufacturers. In addition, the aims and objectives of the study as contained in this chapter are outlined.

The effective management of spares inventory is a critical element for the sponsor company. The reduction of maintenance, repair and operations (MRO) inventories is a relatively neglected area of investigation, with vehicle components and packaging inventories receiving the majority of attention. MRO spares are particularly prone to mismanagement and overstocking as they can be slow moving yet critical to operations. Reducing over-stocking is of strategic importance, especially in difficult economic conditions, to free up financial and physical resources.

Conversations with maintenance, facilities, and purchasing specialists (12 persons in total) at the sponsor company have also highlighted the following features:

1. The purchasing route is often not standardised. Maintenance engineers are in a uniquely powerful position especially when there is a threat of production stoppages. They may be the only people in the company who know the particular requirements of the machine and may use indirect (convenient) means of acquiring stocks.
2. Original equipment manufacturers and suppliers up the chain alter specification numbers to protect their business, meaning that a maintenance engineer cannot easily identify the part which may have a cheaper (and more readily available) generic alternative.
3. Maintenance engineers may use 'squirrel stores' (personally set-aside mini inventories). These are not tracked and the data on their usage is unknown to the wider company.
4. Spares parts inventories may be paid for at the time of usage, meaning their value (and associated depreciation) is not felt at the department level in the same way as work in progress inventories. There is therefore little incentive for maintenance engineers to vigorously check spares lists supplied with new machines.
5. Spares inventories are a comparatively small component of the total cost to a large manufacturer. This means that they are overlooked in favour of 'big ticket' expenses such as raw material costs. Gaining senior management engagement is difficult especially during times of growth when attention needs to be paid to investment in production facilities.

The sponsor company had led previous attempts to reduce its inventory through the identification of duplication and obsolescence. Results were minimal against current stock value

(little incentive for suppliers / manufacturers). It was time consuming activity with minimal impact to actual inventory levels.

The purpose of this study

The aim of this study was to identify suppliers with the capability to provide MRO inventory reduction services under the technical constraints of a large automotive manufacturing facility, and then to operate a trial of their inventory reduction process against the sponsor company's inventory. Specifically, the study sought to develop a repeatable process to identify the suppliers and parts to be included in the resourcing process and then manage a process of inventory reduction that maintained business levels whilst finding cost savings for the sponsor company. The objectives of the study which led to this aim were:

- To identify parts to be included in the trial.
- To identify a supplier to conduct the reduction process.
- To gain buy-in from across the operations of the business.
- To produce a repeatable and adaptable process that can be seamlessly integrated into the wider process of a major automotive organisation.

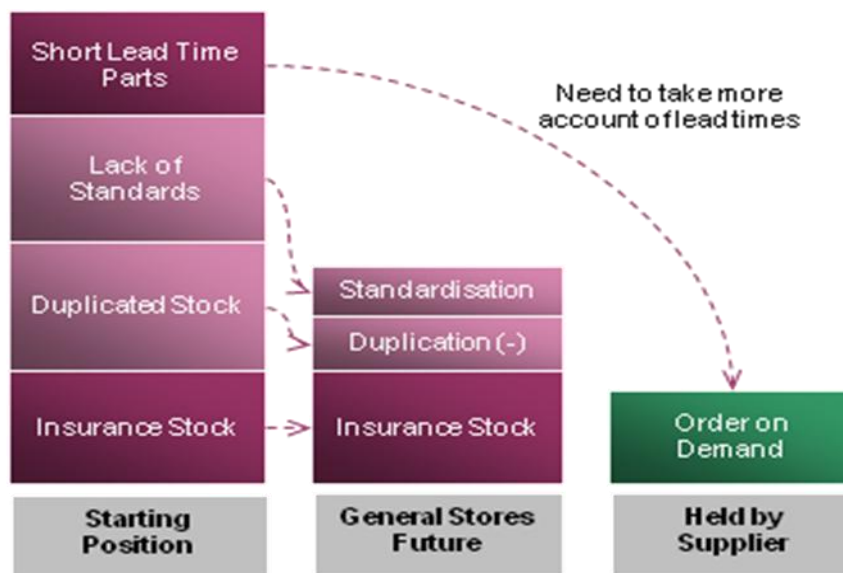


Figure 8-2. Conceptualisation of the goal

Figure 8-2 shows a conceptual model of the purpose of the study. The starting position of the general stores is depicted by the leftmost group of boxes. There is essentially a level of stock which is required to maintain the sponsor company's operations and then additional stocks for which the rationale for holding are less clear. Much of that lack of clarity is due to the fact that

the majority of individuals most closely involved in the acquisition and stocking process are not engineering experts. Through interviews and data analysis the author was able to identify three common problems with the stock held in the general store. Firstly there is duplication of stock, secondly, some stock is held due to a lack of standardisation, and thirdly because incorrect lead times have been assumed or quoted. The study presented in this chapter has therefore sought to identify a novel means of tackling these three issues in a structured and repeatable fashion.

The findings are used to populate the Purchasing Cost and Risk Reduction Methodology (PCRRM) described in Chapter 5. It can be considered to be a feeder process for the other two elements in the methodology (Figure 8-3).

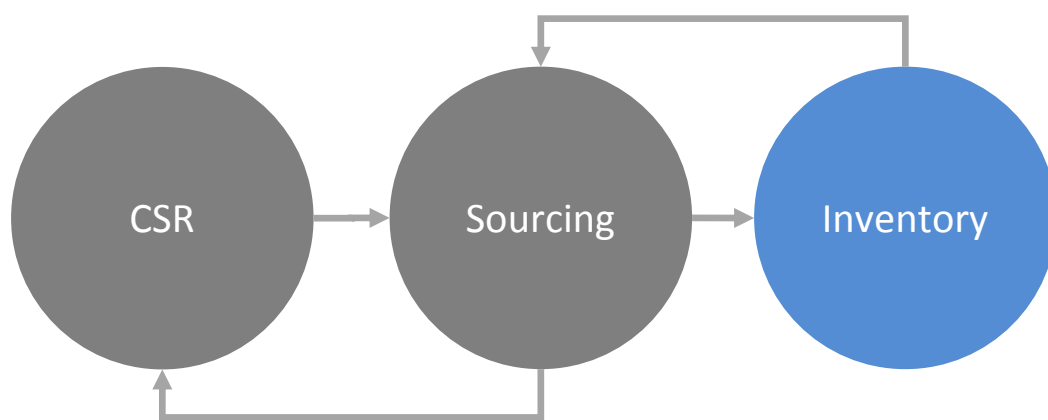


Figure 8-3. Findings of the study as a component of the PCRRM

Practical considerations

The study described in this chapter was conducted in a real world context. There are a number of associated advantages and disadvantages that this form of research can bring.

It would not have been possible to run the study without the expressed approval of each of the sponsor company's senior management and in particular the approval of the purchasing manager. The sponsor company expressed the view that they wanted to keep the work that their suppliers needed to do, in order to participate in the study, to the minimum. That is not to say the study should not probe for the facts but rather it should not be overly protracted and distract from the immediate needs of the business to maintain supply. In addition they made reference to the fact that if the findings of the study were to be implemented in the company, then they should be sympathetic to the needs of a real world operation and not merely the product of a purely theoretical exercise.

The scope of the study along with the practicalities of its implementation were not defined prior to the start of the work. This meant that supplier and internal stakeholder expectations needed to be closely managed. It was especially important to maintain traceability of the process and references at key decision points due to the fact that the study impacted on so many departments and internal business centres within the organisation.

The running of the trial would be especially complex as there was neither a predefined or similar process in operation nor any meaningful systems support available. The nature of trial meant that a number of actors would work on data concurrently and therefore without strong procedures in place the study could be derailed and the quality of the results compromised.

The participating companies were known to be large geographically dispersed, meaning that it was especially important to implement a traceable process which could be managed remotely where necessary. This meant that the process needed to give the supplier as much information about the parts as possible to allow them to make accurate tenders for the business. The process was designed to be thorough but not overly burdensome.

The key actors were identified as being:

- Corporate Services Purchasing Manager
- Corporate Services Purchasing Specialist
- Facilities General Stores Section Manager
- Facilities General Stores Group Leader
- Materials Control Administrator
- Materials Control Manager

8.4 Steps for the Inventory Study

This section presents the two phases of the inventory study (Figure 8-4). Each is discussed in terms of its aim, method of development and implementation, and rationale.

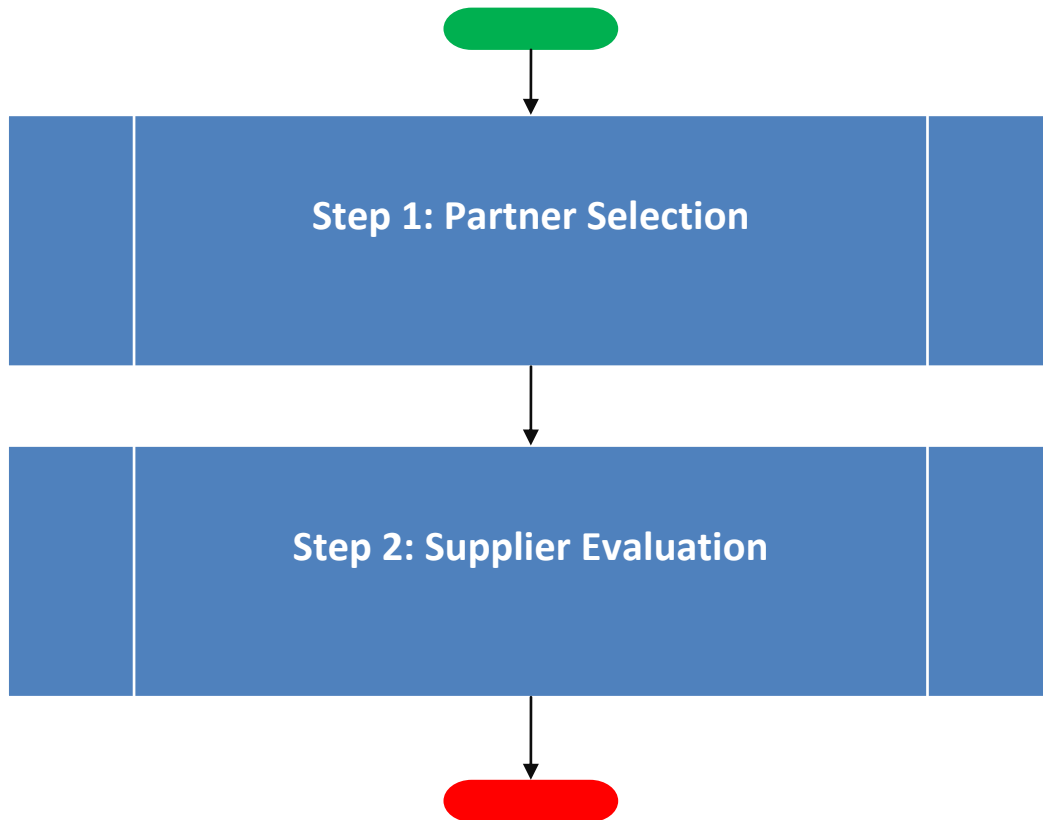


Figure 8-4. Steps for conducting the Inventory study

Step 1: Partner Selection

Aim of this step

The aim of this step in the study is to identify suppliers with the capability to provide MRO inventory reduction services under the technical constraints of a large automotive manufacturing facility.

The purpose of this step was to identify a list of suppliers that were capable of working in partnership with the sponsor company to reduce the inventory level of the general store. The supplier base of the sponsor company numbers over 800 and so a structured means of identifying good candidates was essential. The participant selection step reduced that number to a total of 12 good candidates, in including additional potential partners from beyond the immediate supplier base.

The objectives of this step were therefore to:

4. Identify candidate participants
5. Identify participants from candidate list

6. Develop a repeatable and integrated process

How it was done

The research was carried out in three steps:

- Requirements gathering: Interviews of the Toyota Purchasing Department to understand their requirements.
- Preparation: Literature survey to identify questionnaire structure
- Implementation: Issuing questionnaire.
- Analysis

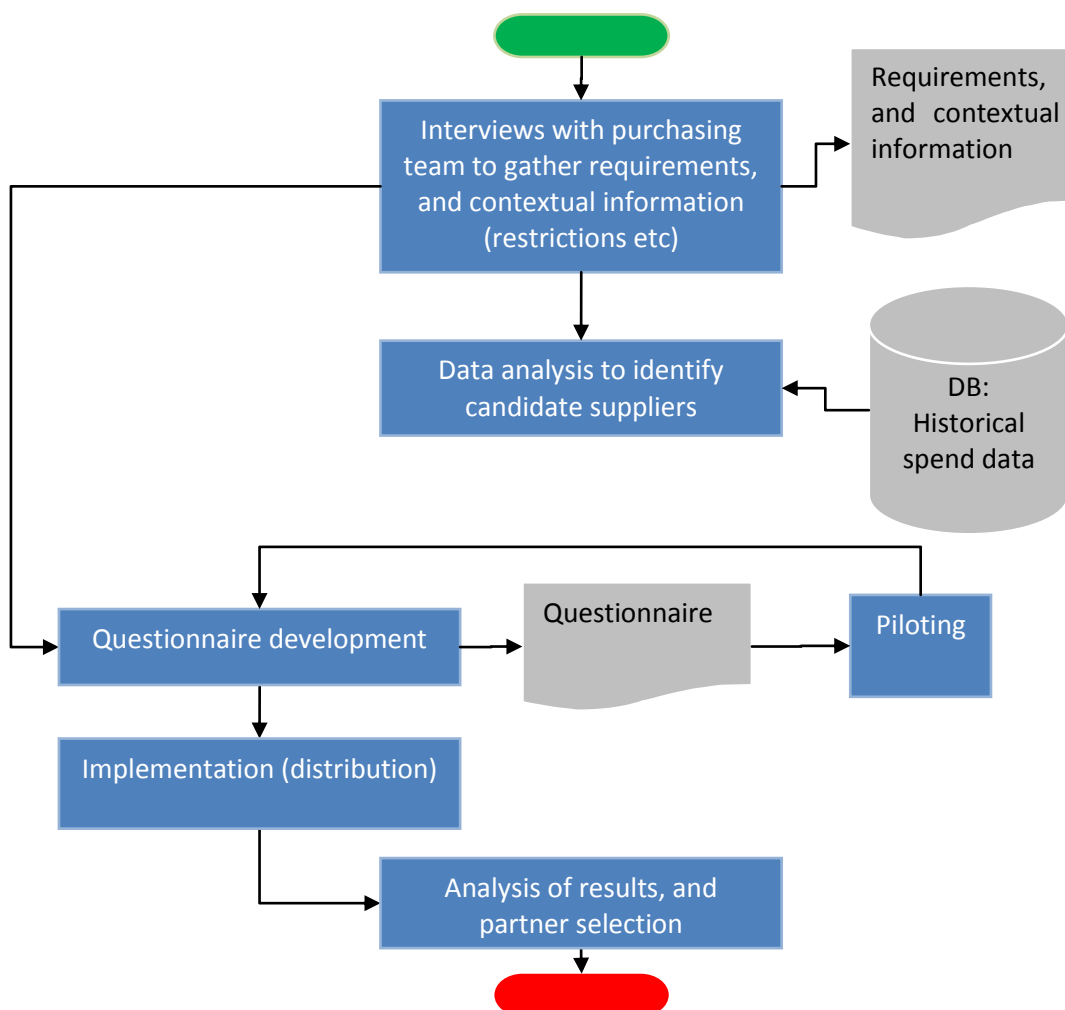


Figure 8-5. Partner selection process

Figure 8-5 shows the end to end process of the step. The literature review confirmed the challenges identified in practitioner interviews and underlined the need to conduct a repeatable process for supplier assessment. The questionnaire (the sections of which are listed below) was

piloted with the help of a specialist services buyer in the company who was not directly involved in this work.

To establish a list of potential inventory reduction partners, twelve candidate suppliers were selected from a list of the most significant suppliers by spend with the company, along with suppliers identified through internet search and industry recommendations. After initial contact with each of the candidates, the questionnaire was sent to the 12 in spreadsheet format via email. They were given 4 weeks to submit their answers. All 12 submitted completed questionnaires.

The sections of the questionnaire were based on the supplier competencies identified during the literature review. The questions were designed in consultation with purchasing specialists in the sponsor company to extract as much relevant information as possible, with the caveat that it should not prove to be a burdensome task to complete or analyse. Several revisions and periods of internal testing were needed before the sponsor company were satisfied that it could be sent on their behalf. The following list gives the format and questions of the questionnaire (the notes in brackets were not included but are used here to further describe the intent of each section):

- Section 1: COMPANY DETAILS (is the supplier of sufficient scale to undertake this project)
 - Number of employees
 - Date company established
 - Main company business
 - Principal customers
 - Annual turnover
 - Net income (before tax)
- Section 2: MRO INFORMATION (what if any similar activities are they involved with elsewhere)
 - Number of years experience implementing MRO solutions
 - Annual turnover from MRO packages
 - Percentage of overall turnover equating to MRO management
 - Experience with vehicle manufacture MRO management
 - if yes, who with, and for how long
 - MRO packages bespoke or generic?
 - Who else do you implement MRO management solutions with
 - General MRO management solutions offered
- Section 3: COMMODITY INFORMATION (do they have the engineering expertise)

- Do you have mechanical expertise, please specify
- Do you have electrical expertise, please specify
- Do you have pneumatic expertise, please specify
- Do you have hydraulic expertise, please specify
- Do you have cutting tool expertise, please specify
- Section 4: WIDER EXPERTISE (can they bring additional knowledge to the project)
 - What other expertise do you have - please specify
 - Do you offer one-off or continuous support packages
- Section 5: INFORMATION SYSTEMS (how will they interact with the company systems)
 - What information systems do you utilise for MRO management

Two senior buyers from the sponsor company separately assessed the responses and evidence provided by the suppliers against a three point grading scale (2 = Good, 1 = Satisfactory, 0 = Unsatisfactory). The majority of the questions asked in the questionnaire returned verbose responses. The buyers used these responses along with supporting evidence such as online financial data, supplier publications and their experience of business dealings to make their assessment. Where agreement between two buyers could not be reached, the lower of the two ratings were used. For example, one of the buyers felt that the responses given by Supplier 4 for their MRO experience were sufficient to be awarded a grade of 2, however the senior buyer who had more substantial dealings with Supplier 4 felt that their responses exaggerated their competency.

Table 8-1 shows the results of the buyer questionnaire assessment. Each of the competencies was assigned a weighting following discussion with practitioners in the sponsor company (Table 8-2).

Figure 8-6 shows the result of multiplying the buyer grading with the competency weighting. As can be seen some suppliers such as S9 and S10 have not scored well in some areas but have sufficiently high scores in the more important areas (such as MRO and automotive experience) to warrant further discussions. Suppliers such as S3 have received a favourable initial grading but when the weighting system is applied their overall score becomes less significant. Using this system of specialist buyer grading alongside a weighting mechanism means that those suppliers who meet the standards of the most significant competencies naturally rise to the top of the assessment. In this way, it is more difficult for peripheral competencies to skew the result.

Table 8-1. Buyer grading of supplier responses

SUPPLIER	FINANCIAL	MRO	AUTOMOTIVE	OTHER	COMMODITY	IT
Supplier 1	0	0	0	0	0	0
Supplier 2	1	2	0	1	1	1
Supplier 3	1	1	2	1	1	2
Supplier 4	2	1	2	1	2	1
Supplier 5	1	1	2	1	0	1
Supplier 6	2	0	0	0	0	0
Supplier 7	1	2	0	1	0	1
Supplier 8	0	0	0	0	0	0
Supplier 9	0	1	2	2	1	2
Supplier 10	0	2	1	2	2	1
Supplier 11	0	0	1	1	2	1
Supplier 12	1	2	1	2	2	2

Table 8-2. Relative importance of each competency

	FINANCIAL	MRO	AUTOMOTIVE	OTHER	COMMODITY	IT
Weighting	0.1	0.25	0.25	0.1	0.2	0.1

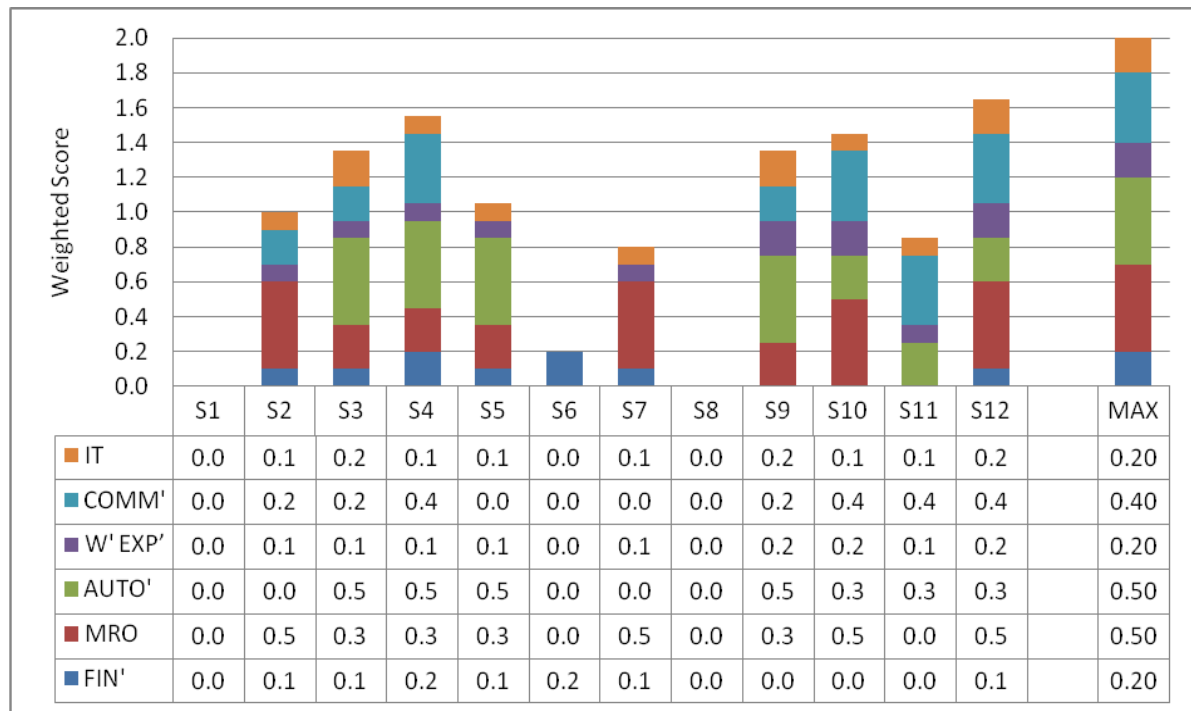


Figure 8-6. Weighted scoring results

Assessing the candidate machine spares services suppliers in a structured form, which is based on criteria found in the literature, can assist purchasing specialists in addressing the practical difficulty in choosing an appropriate partner. In this thesis, the author has explored the rationale behind partnering with a key supplier to reduce MRO inventory in the automotive supply chain. The result of this study was the development of a set of criteria that purchasing managers can use in order to assess potential partners. The use of interviews within the company, along with literature sources, allowed for the development of an industrial questionnaire through which the abilities and merits of each of the prospective companies could be assessed. The work presented here improves the basis for a crucial decision taken by purchasing practitioners working in the automotive manufacturing sector. It details a methodology for the gathering, analysis and synthesis of data required to support an element of wider purchasing best practice.

Section 3 of the questionnaire is designed to find out what specific engineering knowledge the supplier has and relates to the particular manufacturing and MRO requirements of Toyota Manufacturing. These questions should therefore be swapped-out with questions pertinent to the particular manufacturer on a case by case basis.

Suppliers 1 and 8 were identified using historical purchasing transactions and an internet search, and on first impressions of their corporate publications and early email exchanges, they appeared to be appropriate candidates for this work. However, when the structured questions of this

questionnaire were asked, they both failed to provide satisfactory answers (either incomplete or unsatisfactory) to scores in any of the grading areas. This goes some way to confirming that this approach can yield quick and useful results for purchasing practitioners.

Following the supplier assessment shown in Figure 8-6, suppliers 3, 4, 5, 9, 10, and 12 were invited to the next stage of discussions. Suppliers 3, 4, and 9, subsequently decided to form a consortium and submit a joint tender. Supplier 12 submitted an individual tender. The other suppliers were eliminated at this stage. Site visits to two of the current MRO inventory clients of the bidders (a large engine producer working with a member of the consortium and a leading pharmaceutical company working with Supplier 12) confirmed the expertise and organisational fit of Supplier 12 and they were invited to trial their services at the sponsor's plant.

Why it was done in this way

The semi-structured interviews with purchasing practitioners were a crucial first step in understanding the context of the research and limitations the study would face. Using the experience of the practitioners as a basis for designing the study plan, it was possible to more quickly arrive at a point where the research would be able to gain approval before being launched in a live environment. As with the other major components of the work presented in this thesis, the opportunity offered by conducting the research in the live environment of a major manufacturer had both positive and negative aspects. It was essential that for the research to avoid becoming too burdensome to the supplier companies in order to preserve the positive working relationship with the sponsor. In addition, by interviewing the purchasing practitioners, the author was able to identify the aspects of previously deployed projects which would encourage final approval. As well as being a useful sounding-board for the author, this step in the process also promoted the study internally within the wider department. In ensuring, higher early awareness levels, the author gained confidence that future phases of the study would be more easily understood and be more saleable.

The approach described in this chapter makes use of the experience of purchasers, in their ability to assess not only supplier responses but also any past knowledge of a supplier. The reassessment of Supplier 4 shows a weakness in this approach in so much as it becomes more practicable where experienced buyers have a previous relationship or some past knowledge of a supplier. This then leads us to consider whether less well known suppliers' responses can be properly validated. However, it would be difficult to argue that any additional knowledge should be ignored. To address any disparity, subsequent stages of supplier negotiations should include more detailed examination of supplier capability (this was employed in this case study). The

judgement of purchasing practitioners and management remains an important part of the process. This method is the first in a series of stages needed to reach an agreement for MRO inventory services. The aim here is to provide not only an effective but also an efficient tool for practitioners. At the extremes, a series of lengthy and expensive trials for all of the suppliers could be established, or the supplier could be nothing before entering into the tendering stages. Neither of these approaches would be sensible, so the task is to identify where on the scale this initial supplier assessment should sit. Time, cost, and accuracy are the considerations practitioners in the field are dealing with (particularly in these testing economic conditions). The approach described in this chapter is designed to balance these variables and therefore there are inevitable compromises to be reached. The results of these questionnaires represent the initial step in a series of negotiations between the parties which ultimately led to the establishment of vendor managed inventory for machine spares with the sponsor company.

Step 2: Trial Setup and Implementation

How it was done

Setting out the background data for the trial

The company database of parts was analysed to understand the sourcing issues of the parts held in stock. To compile this analysis, the author used the supplier reference along with manufacturer detail to identify parts which were sourced outside of Europe. In the case of the sponsor company it was found that the split of local and non-local sourced parts was close to 50/50 (Figure 8-7).

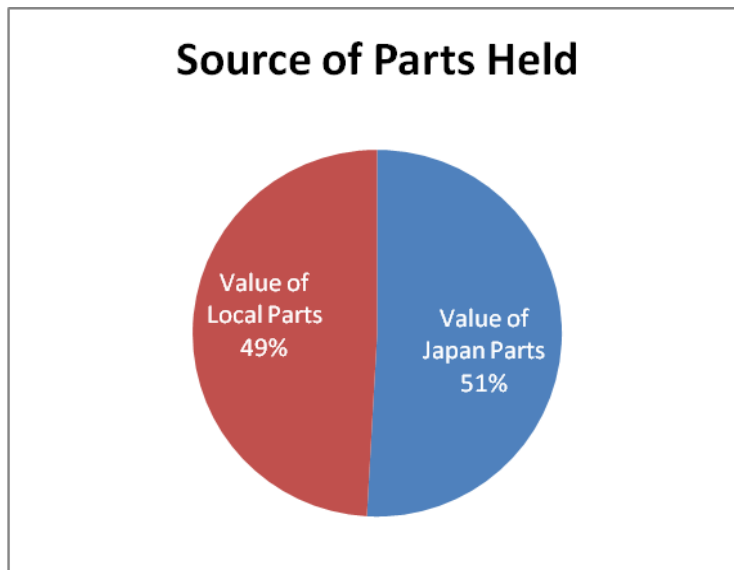


Figure 8-7. Origin of parts held in inventory

The database was also analysed from the perspective of registration of parts. A part is registered as an active part once the request and approvals have been signed off. The data for the years 1991 onwards was collected and summarised for the year on year level. A graph as shown in Figure 8-8 was then produced.

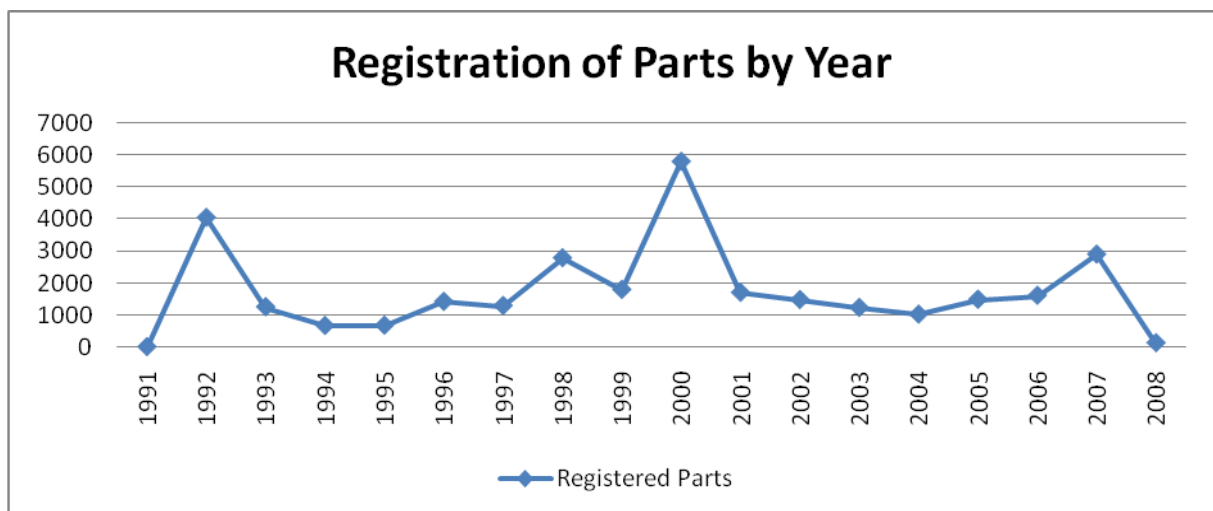


Figure 8-8. Registration of parts by year (thousands)

Parts were also analysed since they were last issued as show in Figure 8-9. This was collated from the main database using both the dates of registrations and the dates of usage. Those parts which were yet to see even a single issue from the general store to a user were the only ones included in this analysis. Of an inventory of £12m, almost 50% of the parts remained unissued, many of which dated back to the opening of the facility.

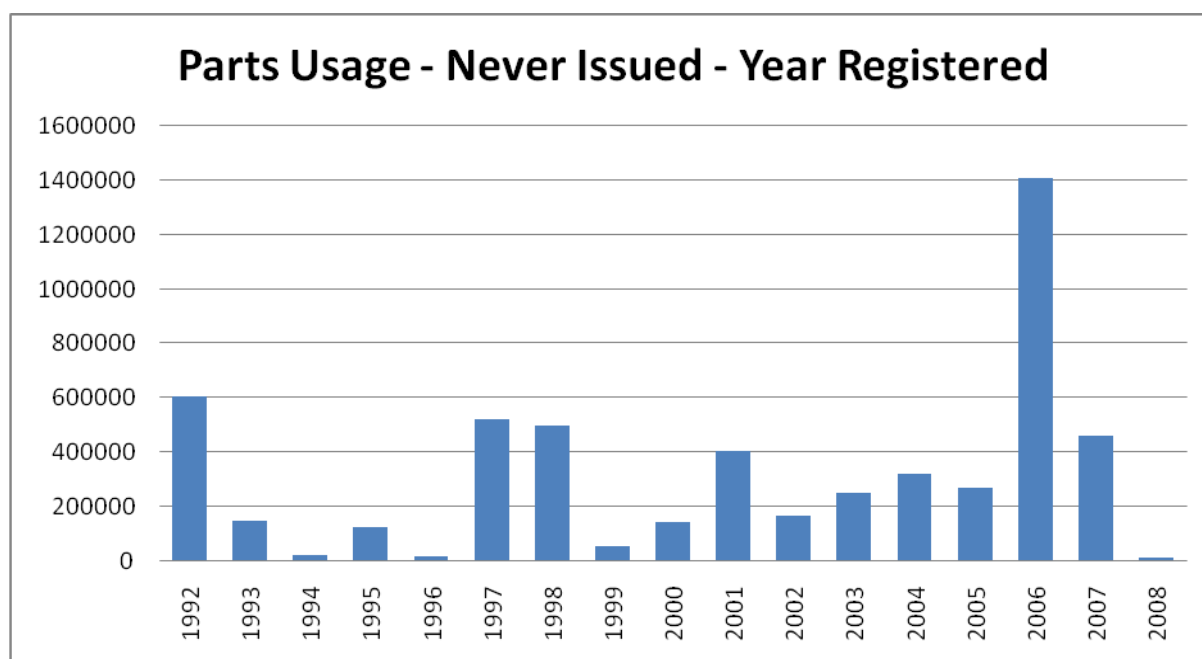


Figure 8-9. Yearly value of parts purchased but never issued (£s)

A further cut of the issues by year versus inventory holding was then made. This time rather than focusing on when the part was registered the data was cut to show which time period previously issued parts associated to. Figure 8-10 shows the output from this analysis. The data was grouped by zero to five, six to nine, ten or more, and no years since issued.

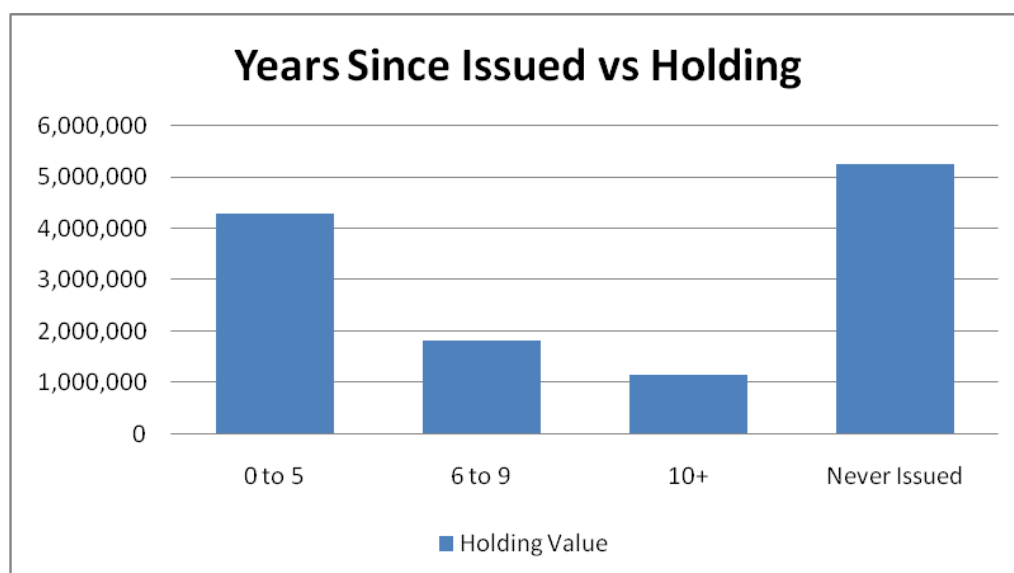


Figure 8-10. The value (£) of stock holding by years since last issued (years)

Implementation of the trial

The starting point for the implementation of the study was to identify the commodities which the supplier would investigate and deliver its analysis and recommendations. Data base was analysed

by inventory levels versus commodity holding. This data was overlaid against the internal matrix of part groups used by the sponsor company and understood to a large extent by the supplier. The process of selection was conducted in a meeting with the supplier, the purchasing team, and the facilities experts. The author plotted the relative importance of each commodity type to begin the discussion process. Five commodities were selected based on agreement between the parties (Figure 8-11).

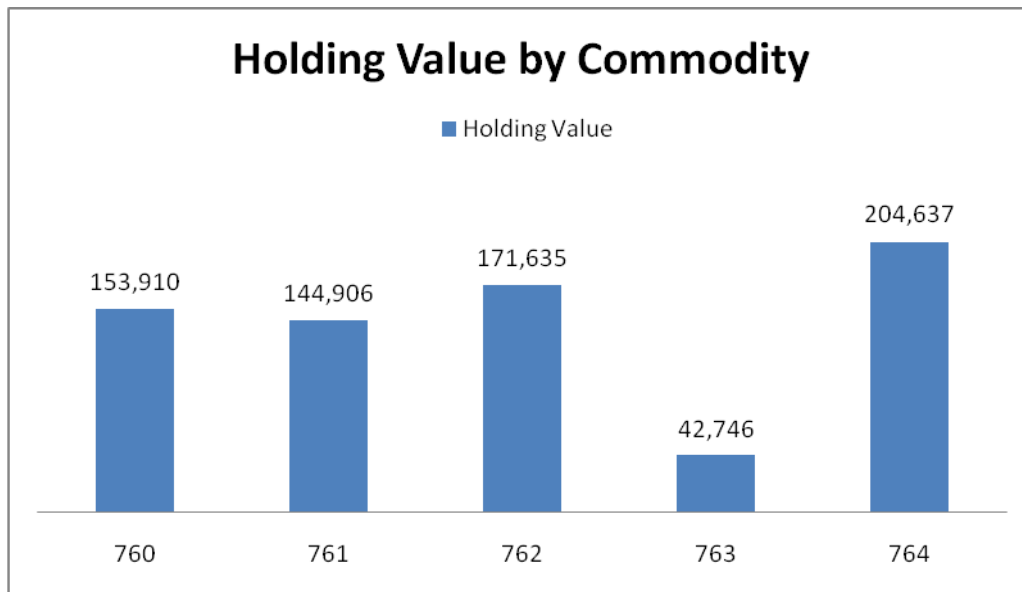


Figure 8-11. Holding value (£) for each target commodity (760 – 764 = commodity groups)

The author then set about developing a framework for managing the exchange of information between the supplier and the three internal parties. This process flow is shown in Figure 8-12. Unstructured interviews were held with production control and facilities with a series of smaller catch-up sessions held over a two week period. In these sessions, the author proposed responsibilities and timings for each group of people working in this process. The process within the supplier's operations was included at a black box level only, with inputs and outputs, but no internal workings shown.

The earliest stages of the trial implementation were conducted by the author directly. Data for each of the commodities was extracted, cleaned, and formatted into usable starting files for the supplier's analyst to begin working. These lists were duplicated for internal and external use, with the external use files lacking sensitive information such as the supplier and line by line costings. Instead, the file given to the supplier had this information grouped and summarised at a higher level.

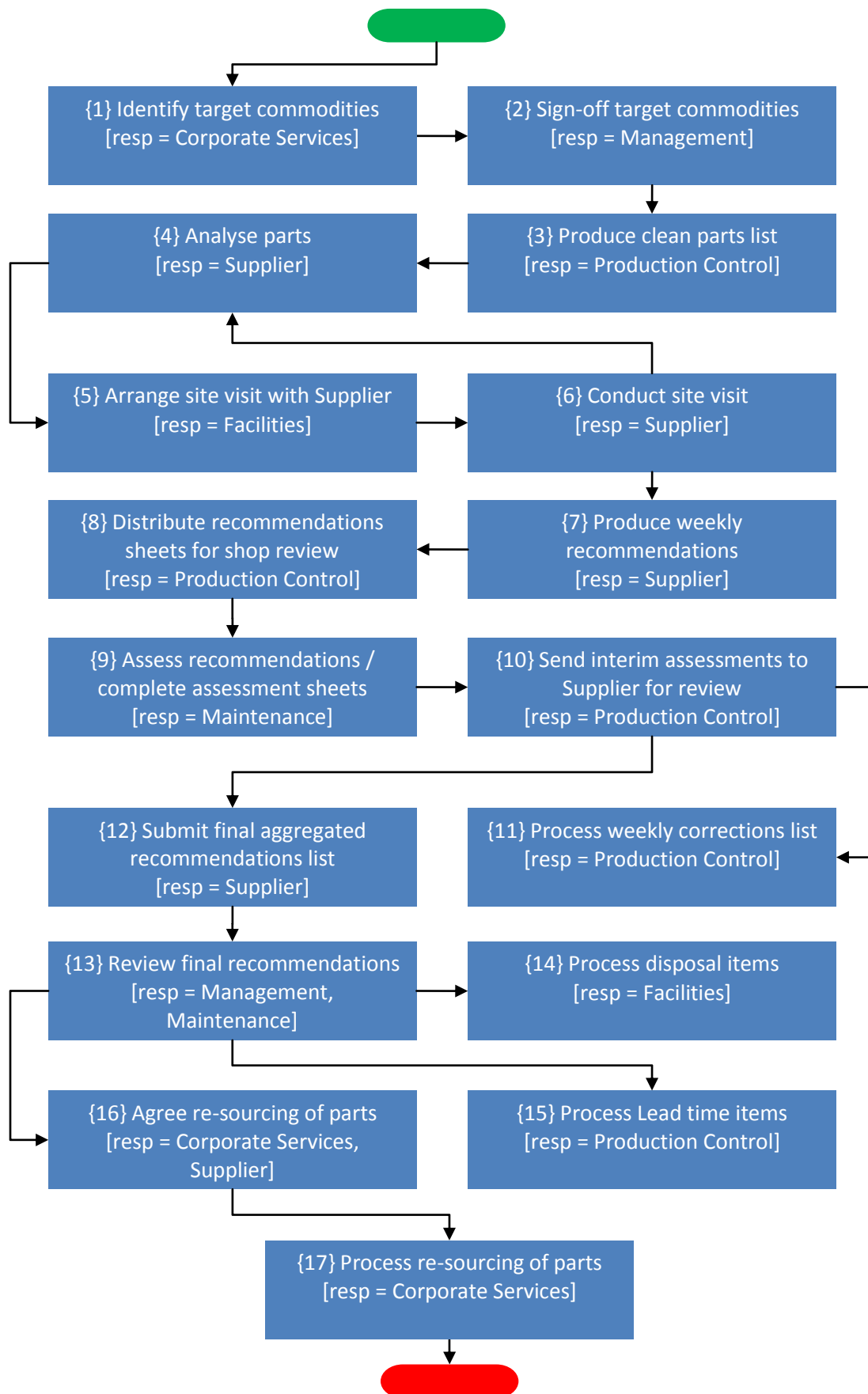


Figure 8-12. Process for managing the trial

The second key stage was to get signoff from senior management that these commodities were suitable for investigation. Once approval had been acquired, the list was sent though to the production control team. The data was to be held by them and they would act as the central point of communication between the internal and external parties.

The supplier was provided with the data for all five commodity groups at the start of the trial. The agreed timetable of analysis was set at two week periods.

Production control was assigned the responsibility of taking the outputs of the data analysis from the author and producing what was termed as a clean parts list. This list excluded parts which were undergoing investigation through another project or had already been identified as items for removal.

The supplier was provided with clean and desensitised list of parts and details for each of the five commodity groups. A timetable of investigation and delivery of findings was established through negotiation. The basic format of this was to allow the supplier up to two weeks to return a list of recommendations for the sponsor company at a part by part level. This timetable was fixed as far as possible given business demands of both the sponsor and the supplier.

The supplier and facilities personnel arranged a two day visit for the supplier to enter the site and inspect the parts. Following this, the supplier was given scope to return to the site for shorter investigative periods as necessary.

The supplier produced weekly updates of progress against each commodity. The recommendations were returned in the standard template designed by the author. This template was agreed upon and signed-off prior to the release of data. The weekly updates were made via email and telephone. At each major milestone, a review session was held between the internal stakeholders and the supplier. At these sessions, the supplier was required to present their findings and recommendations. The recommendations were made in one of two categories, either to remove the part from the order purchase cycle, or to merge part listings into a single identity on the mainframe system and database.

Production control took the recommendations made by the supplier and checked them before sending the findings and recommendations to maintenance specialists for assessment and approval.

Maintenance engineers were required to approve or veto the recommendations put forward by the supplier. For this task, senior maintenance managers were provided with the supplier

findings in the standardised template developed by the author and were tasked with distributing sections of the report to the relevant engineers for analysis. The engineers working on the shop floor were given up to a week to assess and approve or veto any recommendation based upon business need. They were required to provide their rationale.

At this point, the updated files were transferred back to the supplier via production control for further investigation. Conflicts or disagreements were logged on the template sheet and returned to production control. Maintenance managers were given a further opportunity to add pertinent information to the analysis and at this point each file was locked down.

Facilities specialist used the agreed lists to prepare disposal and/or update sheets before preparing for the changes in the general store itself. Production control managed the major element of data and system changes which resulted from the recommendations made by the supplier.

The purchasing team used the files generated through the process as part of its re-sourcing activities.

This end to end process was conducted in a mixture of parallel and consecutive action depending upon the start time of each block of analysis, the availability of engineers at both the supplier and the sponsor company, and the size and complexity of the nature of each commodity.

Why it was done in this way

Setting out the background data for the trial

It was important to understand the original source of the parts held in the store as this may impact on the final reduction solution. Parts which are imported from Japan have much longer lead times and this means the tendency to stock onsite is far greater than for locally sourced parts. Here, the parts considered to be locally sourced were those which were readily available within Europe. In charting this information, it was possible to demonstrate to the key stakeholders and in particular the senior management, that the challenge to reduce inventory was unlikely to be solved using current business practice.

The registration of parts by year was undertaken to demonstrate the peaks in new part requests during key phases in the business cycle. The data was assessed from 1991 onwards to give the most complete picture of the business cycle and consequential increase in the number of parts being requested for any given year. The data shows that, where new models are about to begin

their production cycle, the number of part registrations increases. This analysis is therefore able to show that there is a degree of predictability in the demand for new parts at the macro level.

A combination of both the year registered and the value of the holding demonstrates the nature of the current holding and gives some insight into the reasons why it may never have been used. This analysis shows that the year 2006 produced the highest level of inventory which has yet to be issued. In one sense, this is not surprising as that year was one of machine change and new part requests. The concern for management would be that those parts remain unissued for a prolonged period of time and add to the strain on the general store. In a similar fashion to the registration data, such analysis demonstrates the cyclical nature of machine spare parts ordering and inventory holding. Showing the year by year breakdown of the parts in this way also demonstrates that there are large quantities of parts which are unlikely to ever see any usage for the simple reason that the machine has since been removed. Totalling the holding value in this way demonstrated to senior management that the business had been carrying unnecessary stock for year after year which directly impacts on financial performance.

The never issued data analysis alone could not provide a complete picture of the extent to which the general store was holding unnecessary stock as it omitted parts rarely issued. The analysis shown in Figure 8-10 indicates that two thirds of the inventory is made up of parts which have not been issued in the previous five years. In cutting the data in this way, it is easy to see the extent of the problem and begin to formulate strategies to tackling this issue which will impact on each grouping.

Implementation of the trial

It was important to get sign-off of each major stage in the process. The engagement with senior stakeholders in the business generated momentum and allowed the author to get the time to argue the case at key company meetings. Resistance to change and uncertainty about the impact of the study was evident and therefore in gaining sign-off at each critical stage the author was able to push the programme forward and not be caught in the trap of having to re-justify each decision over and over again.

The production control team was the perfect candidates to handle the flow of documentation and data through the trial process and between parties. As a business function, production control manages similar data transfers as part of regular supply chain activity and has access to critical mainframe control processes. Having a central point of communication was critical to ensure that the process did not unravel under the weight of data being manipulated by internal and external

specialists. Without this central point of communication between the supplier and the sponsor company, the flow of communications would have quickly descended into an entangled mass of files and analysis.

Providing the supplier with as much of the data as possible up front was key for the planning stage. The commodities were not of equal size and therefore required different lengths of time to complete the investigations. In addition, the nature of the parts within each of the commodities meant that some of the analysis was more complicated for the suppliers' engineering teams to undertake and required specialist support.

Producing the clean parts lists important to ensure that the suppliers did not waste effort on areas where it was known that their recommendations would be undermined in some way, either through no longer being necessary or contradicting the findings of another programme of study. In a large organisation such as the sponsor company, there are numerous activities being undertaken simultaneously. The engagement process with working groups and senior stakeholders was therefore all the more necessary to ensure that any overlap was minimised.

The timings of updates and reviews were critical to moving the trial through each major milestone at a pace acceptable to the needs of the sponsor company. The difficulty with this issue was the throughput of key bottlenecks in the flow and analysis of data. Both production control and the supplier specialists had finite ability to process the data and make decisions based upon that. With this in mind, the author established a rolling review and update process which allowed each participant to use learning's of the best ways to work together as quickly as possible. Namely, the first commodity group to be assessed was judged be one of the easiest in terms of both brevity and depth. In addition, this commodity was analysed alone without the detraction of other commodity analysis being started. The supplier and internal stakeholders were able to learn from this first attempt and adapt their methods to make the best use of their joint availability.

The visits to the general store were very useful for the suppliers because it allowed them to put into context the parts they were analysing. For instance, the physical dimensions of some parts meant that they were areas of less concern because they occupied much less space. In addition parts which were easier to identify by eye allow the facilities specialist to keep track and prevent duplications before they occur. The visits also helped the supplier and facilities personnel to build close working relationships. Although difficult to measure the author was keen to promote this

interaction. It was also important to allow the supplier to make follow up visits at relatively short notice to increase their throughput and prevent delays.

The weekly updates against each commodity analysis proved useful for production control to keep track of progress and to make challenges to the methodology that the supplier engineers were using to make assessments. It would not have been appropriate to require/allow the supplier to go and conduct several weeks of analysis without this feedback loop. The supplier benefited from these updates also, as it helped to focus their energies into the most important areas first. The requirement to make modest but accurate presentations to the internal stakeholders encouraged the supplier to have a sense of urgency.

The requirement for maintenance engineers to approve or veto recommendations from the supplier was the most critical step in the process. Without this step the trial could not have gained approval from senior management. Maintenance engineers and managers were concerned that inventory reduction would impact on their ability to service machinery throughout the plant. It was apparent to the author that the trial needed to take these deeply held concerns into account if it was to be approved at all. However the issue of approval was not the only reason for this stage of the analysis. It was found by the author that a very limited subset of personnel on the site were equipped with the knowledge to challenge the suppliers findings. By including maintenance engineers in the approval process, the trial acquired a valuable resource. In addition, as the final users of many of the parts, maintenance engineers were able to provide the supplier with useful information for some of the more critical aspects of the analysis. Further, by getting their buy-in to the trial, the author and the purchasing department were more confident that the trial could be expanded in the future because the precedent had been set.

In using a structured template for all communications and data manipulations, the author was able to ensure that the process remained on course throughout the trial.

8.5 Discussion

The study described in this chapter was the final and most substantial component of the methodology proposed in this thesis. It has brought together the key elements of risks and sourcing and applied them to the context of machine spares inventory reduction/management.

The concept of inventory reduction appears relatively straightforward but it has proven to be difficult to tackle. There are several key issues facing companies with regard to their machine spars inventory. The first and most obvious is that the nature of the parts being held means that

regular inventory analysis techniques cannot be applied. Machine spare usage is intrinsically unpredictable. Robots and other large machinery on the line fail and break down throughout the year. The failures are numerous, complex, and in large part non-predictable. Regular wear and tear on machine can inform the decision process of whether to stock a part, but it cannot at the micro level tell the supply chain operatives precisely if or when that part will be required. In addition machine spares inventory suffer from a lack of naming standards across the industry, amended specification details as the parts pass through the supply chain, often unsupportive original equipment manufacturer or second/third-tier suppliers, and a mismatch between the knowledge of the end user and the engineer who produces the bill of materials and other specification documentation. These concerns generate and promote a risk averse culture where far too many parts are stocked than will be seen to be needed after the fact. However, this decision to stock as much as possible just in case the worst should occur is completely understandable on the part of those personnel who are judged against machine up time.

Prior to this study, there were limited checks on parts to see whether a similar / same part exists and is located somewhere on site. This is due to the size of the problem. Tracking obsolescence of parts across so many machines and for machines which may arrive from Japan without a proper translation of specification details means that the issue of understanding what should and should not be stocked quickly becomes impenetrable.

The key causes and symptoms of incorrect stocking policies were found to be:

- Duplication
- Obsolete parts
- Lack of standards for naming parts
- Varying standards from suppliers / manufacturers in naming parts
- Storing child part and full assemblies of parts

This trial has shown a structured and above all useful means of tackling these problems by reducing the actual size of the problem. A key issue for those wanting to approach inventory reduction has been that the problem can be seen to be too big to tackle. By reducing the inventory commodity group, the trial has shown that it is possible to coordinate experts, users, and administrative personnel into making progress. A side benefit from this work has been the improvement of data accuracy. The supplier was able to provide up to date specification details

that will contribute in a substantial way to reducing the risks of reoccurrence. Moving the holding location of parts from the general store means that facilities engineers have physically less stock to manage and can therefore dedicate more of their efforts to improving their processes and managing the stock that really does need their attention.

The localisation of sourcing and inventory holding also links in well with one of the key focuses of the programme of work presented in this thesis, namely to green the supply chain and reduce risks from overly wide sourcing channels. The supplier has benefited from this work in a number of ways. Perhaps most key for them has been the development of a much closer relationship with a key client. In addition, they have been able to secure additional purchasing spend as the sponsor company has rewarded their contribution to the process with increased business. By moving inventory from the site and into their own stores, they have also ensured repeat business. In doing so this has helped the sponsor company reduce costs and risks of warranty tracking/management.

The major benefits that this study has realised can be summarised as:

- Optimise stockholding and resource allocation
- Decrease the value and number of items in General Stores
- Reduce the number of redundant stocks
- Decrease inventory investment
- Cleanse data
- Monitor and track duplication
- Decrease duplication for ordered and held parts
- Monitor and track obsolescence
- Decrease obsolete stock held
- Asset management - warranty tracking / shelf life tracking

The final results of the trial can be seen in Figure 8-13, Figure 8-14, and Figure 8-15.

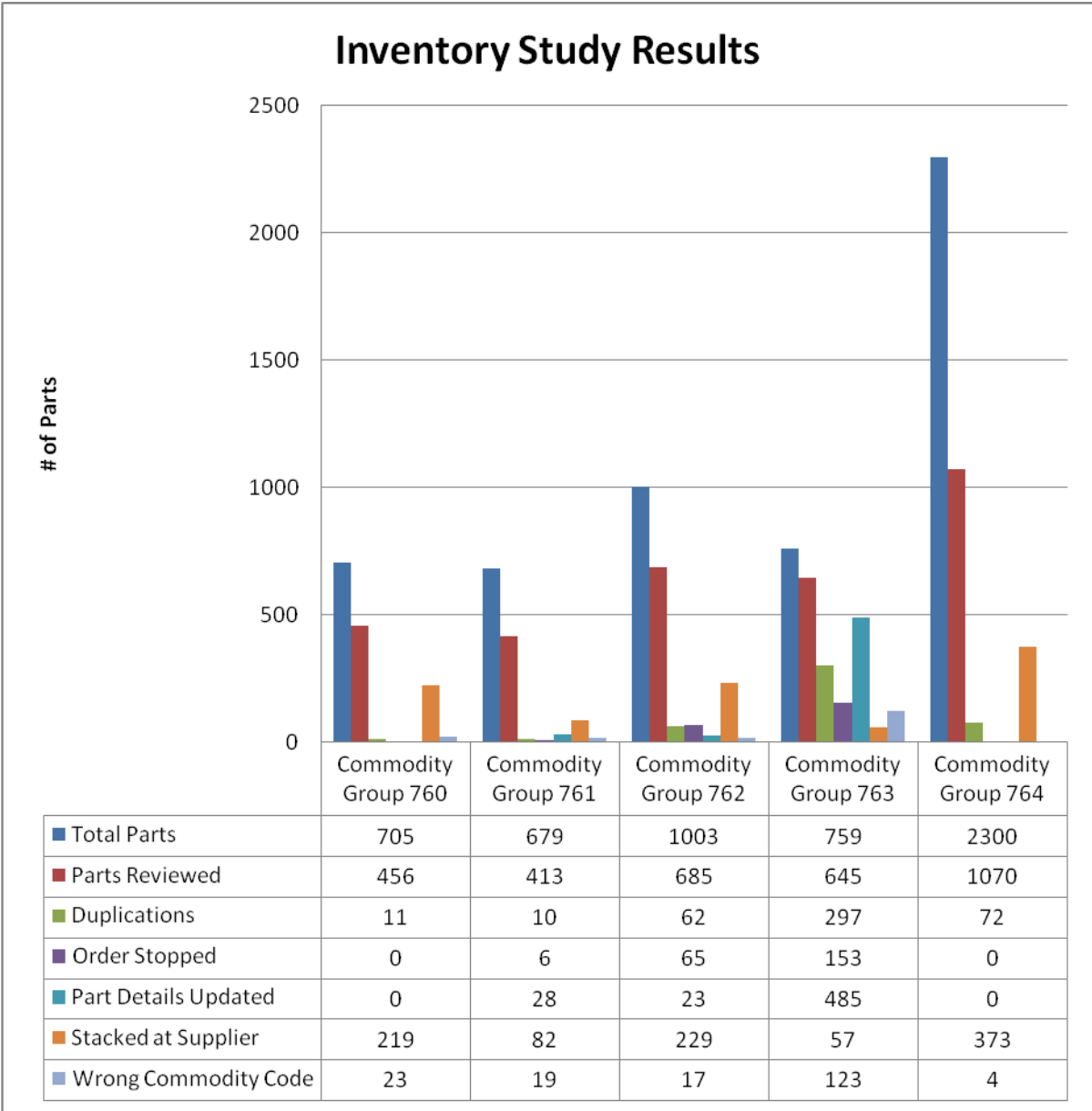


Figure 8-13. Inventory study results by commodity group / number of parts

Figure 8-14 and Figure 8-15 show the monetary savings the study achieved. The study produced a 7.8% saving on the value of stock investigated. The majority of this saving came from zeroing the stock and ensuring that it could not be reordered. The remainder was achieved through the identification of duplications which allowed the stock to be burnt off naturally.

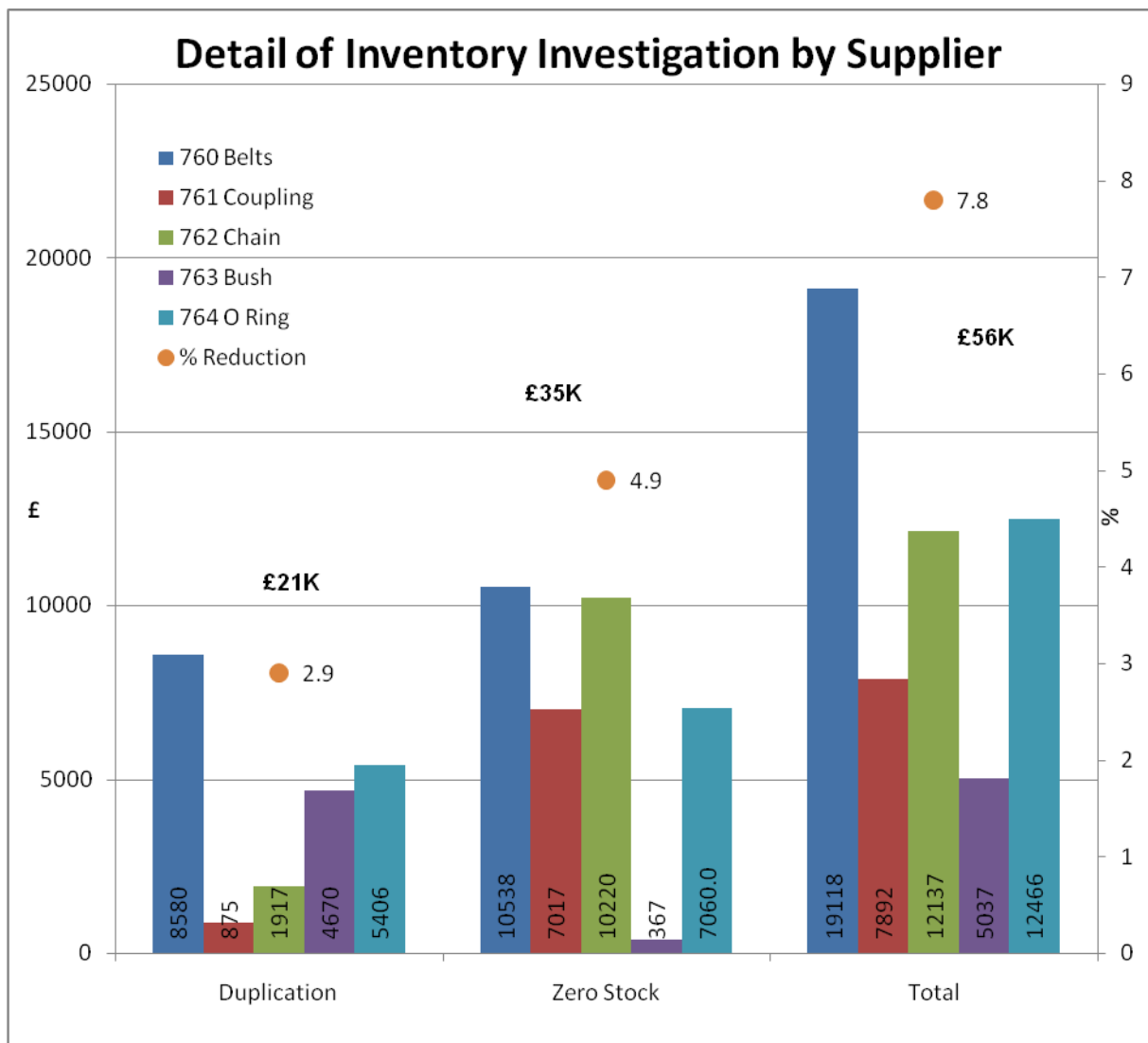


Figure 8-14. Inventory results by reduction strategy / value (£)

Reviewing the store by general commodity area focused the study onto areas where there is a higher probability of duplication and/or obsolescence identification. This option created maximum levels of identification. The resource/time investment was also much less than a complete stores survey.

Reviewing everything in the store would have been the most comprehensive, ensuring that every part category was considered in detail. It would also have been the most costly, both in terms of time and resource. It would also be the most difficult to manage. In addition a proportion of parts identified for removal (in whatever form) would be insignificant in value and/or already written down to zero. This would therefore have undermined the cost/benefit ratio.

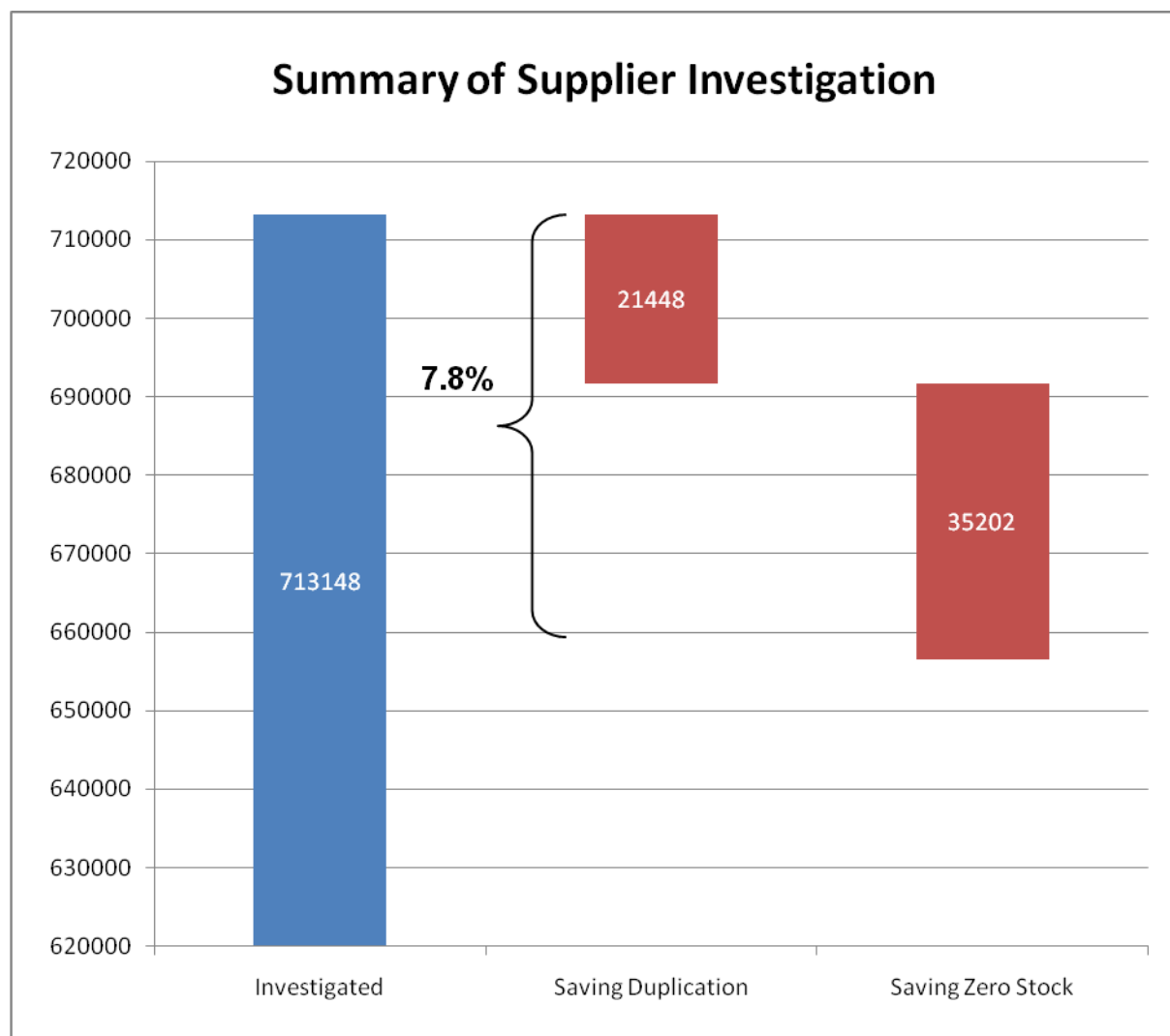


Figure 8-15. Summary of inventory reduction results by value (£)

8.6 Summary

This chapter explored the process of reducing inventory levels for machine spares and general consumables, while maintaining operational efficiency and cost levels. The chapter began by introducing the nature of machine spare inventories and the issues related to their management and reduction. The main body of the chapter presented a structured approach to tackling these issues, developed through literature and field research.

The results of the research are current and reflect the changes in technology and business climate that have occurred in recent years.

Chapter 9

Validation

9.1 Introduction

This chapter presents the work carried out by the author to validate the Purchasing Cost and Risk Reduction Methodology (PCRRM) which was developed through chapters 5 to 8. The process and results discussed here pertain to the validation of the PCRRM at the methodological level. Earlier chapters have offered the reader an insight at the granular level, giving specific results achieved in the application of each component. To offer a thorough validation, it is therefore necessary to consider the PCRRM as a whole, and pay closer attention to the features and limitations of the proposed methodology itself.

The chapter begins by giving some background information as to how and why the evaluation and validation process was developed and used. The questionnaire developed and used during the evaluation process is then discussed and explained. Following this, the results of the evaluation process are presented and analysed in detail. Additional information found during the evaluation is then discussed before a summary of the validation process is described.

9.2 Chapter Structure

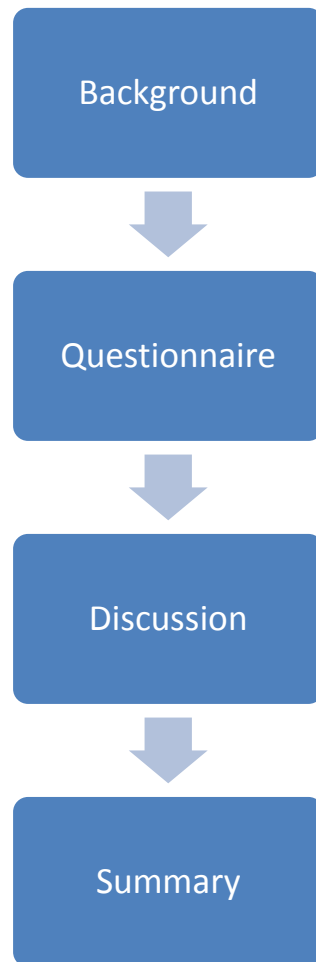


Figure 9-1. Chapter structure

9.3 Background

This section presents the background of the evaluation process, including the aim of the work, an overview of how the process was established and who participated in it.

Aim

The aim of this work was to establish a thorough and fair means of assessing the PCRRM's ability to deliver cost and risk reduction to practitioners in the field of purchasing and supply management. Specifically, the validation process set out to investigate whether the components of the methodology, when used in unison with one another, deliver for manufacturing organisations real and substantive benefits. In answering these questions, the validation process would be able to support the author's claim to have met the remaining research objectives described in Chapter 1, namely to:

- *Design a skeleton methodology for strategic purchasing...*
- *Validate the research results... through structured interviews of experts.*

Setup and Participant Selection

In order to establish whether the proposed PCRRM had met the research objectives, it was necessary to design a rigorous means of measuring the attributes of the methodology. Each of the PCRRM's components was already validated at the granular level as described in earlier chapters, and therefore the logical approach to take in this stage of validation was to consider the PCRRM at a higher level. To do this the author designed an evaluation questionnaire which would be presented to two panels of reviewers (full results in Appendix C). The first panel would consist of academics, and the second of industrial practitioners. The rationale for this approach was that these two groups offer different perspectives and have differing core competencies. The eventual users of this methodology may come from either background, practitioners may use the PCRRM in a live environment, academics may use the PCRRM as a subject of further research or as a basis for other investigations. Using both academics and practitioners would enrich the validation process and cast the strongest possible light upon both the pros and cons of the proposed methodology. Analysis of the PCRRM when undertaken by academics would likely fall upon the theoretical implications, merits, and weaknesses of the work. In contrast, a practitioner's focus would likely be on the real world implications, and whether the PCRRM represents a sensible approach to cost and risk reduction in the purchasing and supply management field.

The academic participants used in the evaluation process were selected from the Manufacturing Department at Cranfield University. They consisted of two research fellows, and two PhD

researchers/students. The industrial practitioners were two employees of the sponsor. Both the practitioners had several years of buying experience and were currently working in the purchasing department of the sponsor; however neither were involved in the development of the methodology during earlier stages of the research.

9.4 Questionnaire

Concept

The author wanted to make the process of evaluation both rigorous and informative. The best way to achieve this was to formalise the process as far as possible. This approach has been found to be beneficial in earlier stages of the research and was therefore the favoured option for the evaluation. The author also wanted to ensure that there remained a balance between rigour and practicality.

Delivery

The validation process was conducted over two days. The purchasing practitioners were visited first, and were given a 45 minute presentation on the PCRRM. On a separate day, the academic evaluators were given the same presentation and materials. Both of the presentations were given in a semi-formal manner with questions raised throughout. The basis for the presentations was the PCRRM. Following the presentations, the evaluators were given the questionnaire and asked to complete and return. Questions were also taken at this stage to ensure that each of the evaluators understood the process. The rationale for this approach is that it is difficult to understand a research project and its output without having a completed thesis to hand. This was not possible at that stage and therefore the author's presence compensated for this shortcoming. It would have been unreasonable and counterproductive to expect the evaluators, even the academics, to be able to give an informed opinion, based solely on a printed copy of the PCRRM and without any other background information. It was therefore appropriate to conduct these sessions face to face with hard copy materials available for each evaluator to refer to during and after the event.

Scaling

The author was keen to ensure that the evaluators considered as many characteristics of the methodology as possible without being overloaded by the whole process. To assist the evaluators in doing this, a standardised scale for considering each aspect of the PCRRM was offered, with the opportunity to add further comments wherever chosen. A scale as presented below (Figure 9-2) was used as the basis for all but two of the questions used in the

questionnaire. This gave the evaluators a structure with which to work, and would allow complete analysis and cross-comparison of responses by the author later in the validation process.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☐

Comments:

.....

Figure 9-2. Standard scale

Design

Each of the sections and questions used in the questionnaire are now presented. The majority of the sections and questions used in the questionnaire were developed from the work of Chandraprakaikul (2008) as well as Platts (1994). The aim of the questionnaire design was to give both a wide and deep analysis of the PCRRM and to consider the methodology from a number of angles. The questionnaire was made up of five sections of questions labelled as sections A to E.

Section A. Feasibility

The first section in the questionnaire was feasibility. This section intended to understand the practicability of the proposed methodology and whether or not it would be likely to be viable. The questions asked in this section were:

- (Completeness) The methodology comprises relevant components of cost/risk reduction for purchasing and supply management.
- (Consistency) The sequences of tasks within the methodology are consistent with one another.
- (Applicability) The methodology could be successfully applied in other similar contexts.
- (Contingency) The methodology provides the user with alternative solutions depending upon the data and context of the application.

Section B. Usability

The second section in the questionnaire was usability. This section intended to understand the likely ease of applying the proposed methodology. The questions asked in this section were:

- (Time) The time required to implement/apply the methodology is within desirable limits.
- (Ease of Use) The tools and techniques within each component are realistically usable.
- (Understanding) The aims and actions of the methodology are clear.
- (Flexibility) The methodology is sufficiently flexible in application.

Section C. Usefulness

The third section in the questionnaire was usefulness. This section intended to understand the effectiveness of the proposed methodology and whether or not it would be likely to be convenient in usage. The questions asked in this section were:

- (Efficiency) The methodology requires reasonable resources to implement/apply.
- (Satisfaction) The results fall within acceptable limits/expectations.
- (Success) The methodology was successful in meeting the aim/objectives.
- (Practicality) The methodology is practical/realistic.
- (Benefit) The methodology brings benefit to purchasing and supply practitioners.

Section D. Modification

The next section of the questionnaire was modification. This section was included to allow the evaluator to identify the component of the PCRRM that they felt was the strongest and the component that they felt was the weakest.

- Which component of the methodology is most useful and why?
 - CSR Acquisition Inventory
- Which component of the methodology is least useful and why?
 - CSR Acquisition Inventory
- Further comments

Section E. Design Features

The final main section of the questionnaire was design features. This section differs slightly from previous sections as it looks more closely at the methodological qualities of the PCRRM. It

considers how valid the proposal is as a methodology in its own right. The questions asked in this section were.

- (Strategic Link) The methodology provides a link between corporate strategy and purchasing decisions.
- (Core Activities) The methodology successfully handles core activities.
- (Holistic Approach) The methodology provides a holistic approach to purchasing and supply issues.
- (Non-Financial Factors) The methodology successfully handles financial and non-financial factors.
- (Initial Investment) The methodology can be applied without substantial initial investment.
- (Continuous Improvement) The methodology can be used as part of a continuous improvement programme.
- (Structure) The procedures are well defined, in a step-by-step approach.
- (Documentation) The methodology provides a well documented record of processes and results.
- (Tools and Techniques) The procedures of the methodology are appropriate.
- (Participation) The participants required by the methodology are appropriate.
- (Project Management) The methodology provides/retains useful data for project planning.
- (Deliverables) The product/outcome is useful for practitioners.
- (Scope and Objectives) The methodology describes well-defined objectives.

Section F. Any other comments

The questionnaire concluded by giving the evaluators the opportunity to give any comments they may wish to share.

9.5 Results

This section presents the results of the evaluation process. Having gathered the responses from each of the evaluators, their responses were coded into a spreadsheet for analysis. Using the scale identified earlier in the chapter, it was possible to give a numerical equivalent for the majority of the responses given by the evaluators. The list below shows how the responses for each question were awarded points for later analysis.

- Strongly Disagree = -2 points

- Disagree = -1 point
- Neither Agree Nor Disagree = 0 points
- Agree = 1 point
- Strongly Agree = 2 points

This approach allowed the author to easily compare across evaluators, sections, and questions, to identify strengths and weaknesses.

The following sub-sections set out the responses received for each section and question. Firstly, the responses from the four academic evaluators are given, and are shown in red tables with red graphs. Secondly, the responses from the two purchasing practitioners are given, and are shown in blue tables with blue graphs. Finally, the combined results (equally weighted between the two groups) are given, and are shown in green tables with green graphs.

In the following tables the columns labelled C, J, M, and W represent one of the academic evaluators (each letter being the initial of their first name). Likewise, the columns labelled A and V represent the first initial of each of the practitioner evaluators.

Feasibility

It can be seen in Table 9-1 and Figure 9-3 that the academic evaluators judged the PCRRM favourably across all areas of feasibility. The strongest area being completeness of the methodology and the weakest the contingency, although even there the evaluators considered the methodology to be favourable.

Table 9-1. Section A - Feasibility : Academic Results

Section A. Feasibility	C	J	M	W	Academic Average
Completeness	2	1	1	2	1.5
Consistency	2	2	0	1	1.25
Applicability	2	1	1	1	1.25
Contingency	2	1	1	0	1

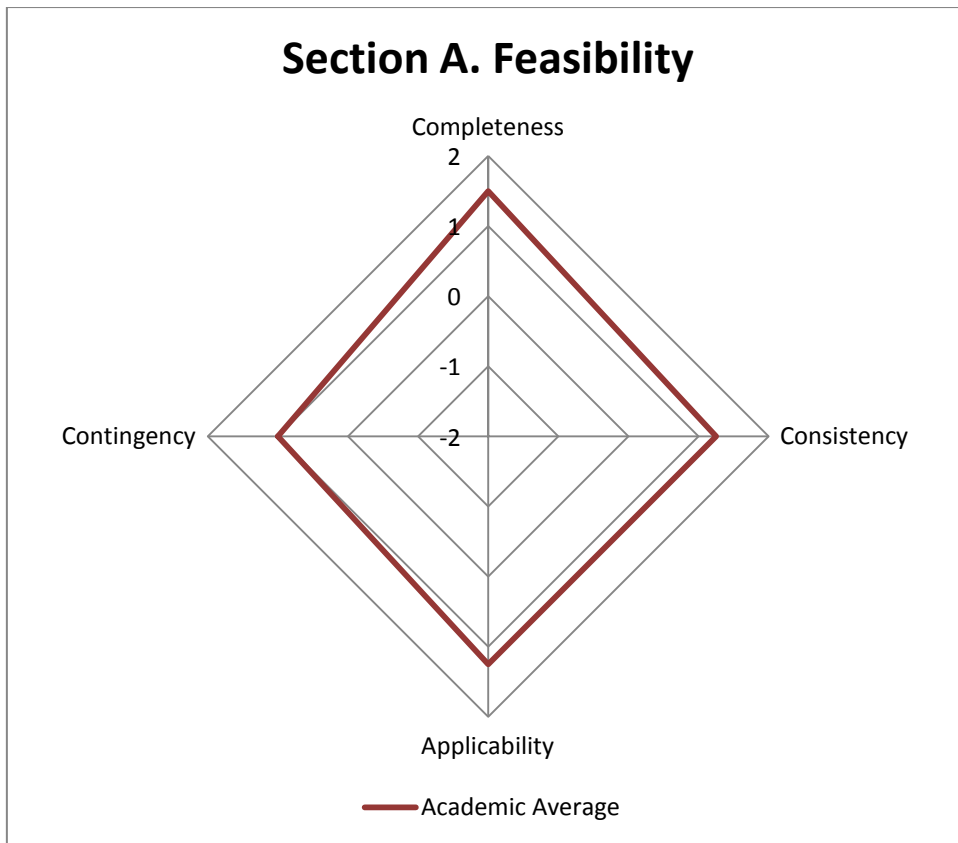


Figure 9-3. Section A - Feasibility : Academic Results

Important considerations that result from this stage of the evaluation are that the consistency and contingency have both scored one zero score.

It can be seen in Table 9-2 and Figure 9-4 that the practitioner evaluators judged the PCRRM favourably across the majority of the areas of feasibility. They offered lower scores than the academics in each area. Again contingency was considered the weakest element of the methodology in this section.

Table 9-2. Section A - Feasibility : Practitioner Results

Section A. Feasibility	A	V	Practitioner Average
Completeness	1	1	1
Consistency	1	1	1
Applicability	1	1	1
Contingency	0	1	0.5

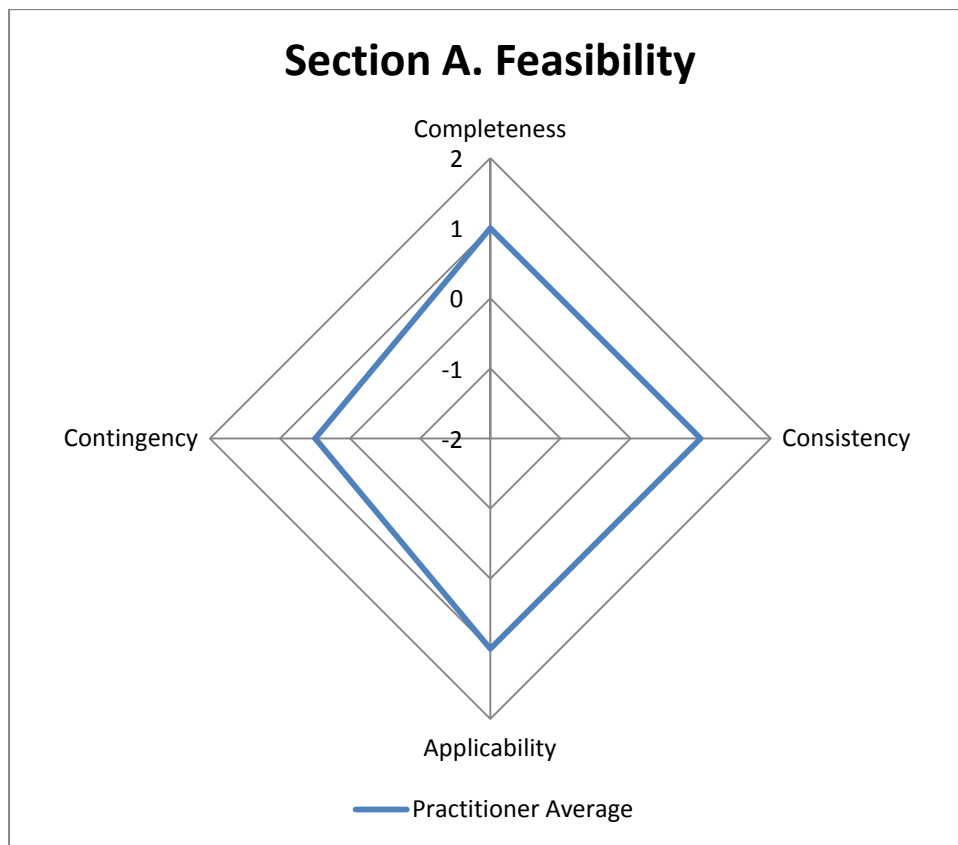


Figure 9-4. Section A - Feasibility : Practitioner Results

An important consideration that results from this stage of the evaluation is contingency which has scored one zero score.

It can be seen in Table 9-3 and Figure 9-5 that the combined average of both groups judged the PCRRM positively across all areas of feasibility. The weakest aspect being contingency, although this area still scored on the positive side of the scale.

Table 9-3. Section A - Feasibility : Combined Results

Section A. Feasibility	Combined Average
Completeness	1.25
Consistency	1.125
Applicability	1.125
Contingency	0.75

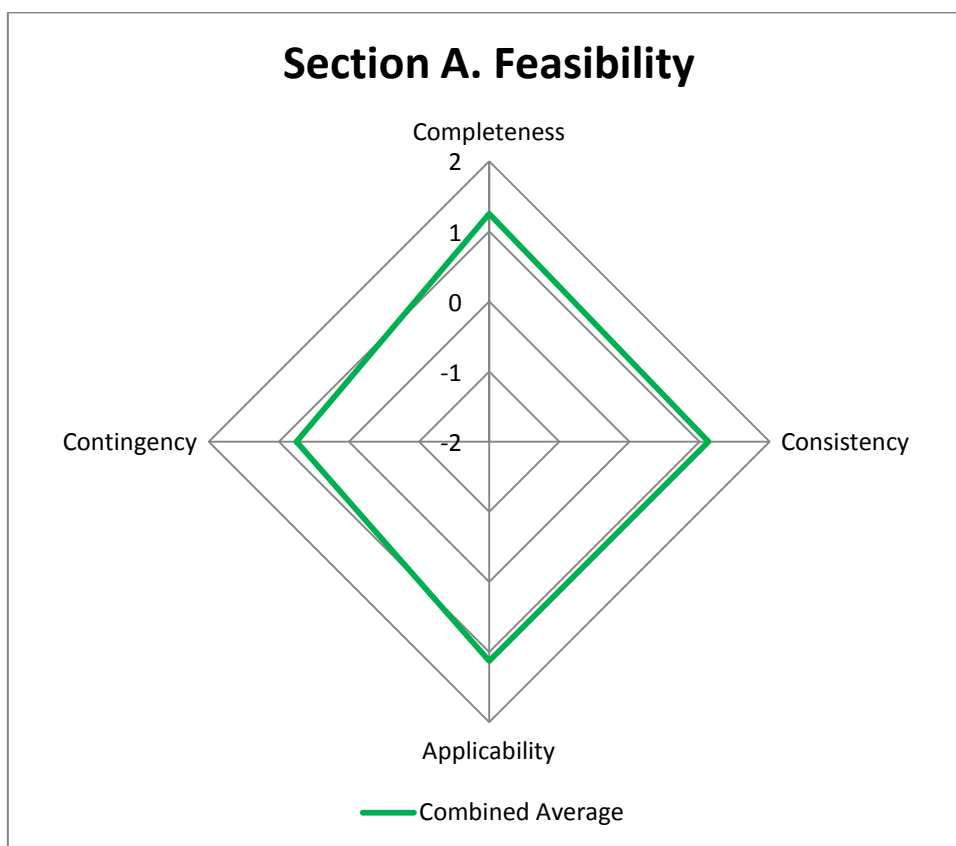


Figure 9-5. Section A - Feasibility : Combined Results

An important consideration that results from this stage of the evaluation is that contingency has received the most negative scores overall.

Usability

It can be seen in Table 9-4 and Figure 9-6 that the academic evaluators judged the PCRRM favourably across all areas of usability. The strongest area being the ease of use of the methodology and the weakest being time, although even there the evaluators considered the methodology to be favourable.

Table 9-4. Section B - Usability : Academic Results

Section B. Usability	C	J	M	W	Academic Average
Time	1	0	1	1	0.75
Ease of Use	2	2	1	2	1.75
Understanding	2	1	0	1	1
Flexibility	2	1	0	1	1

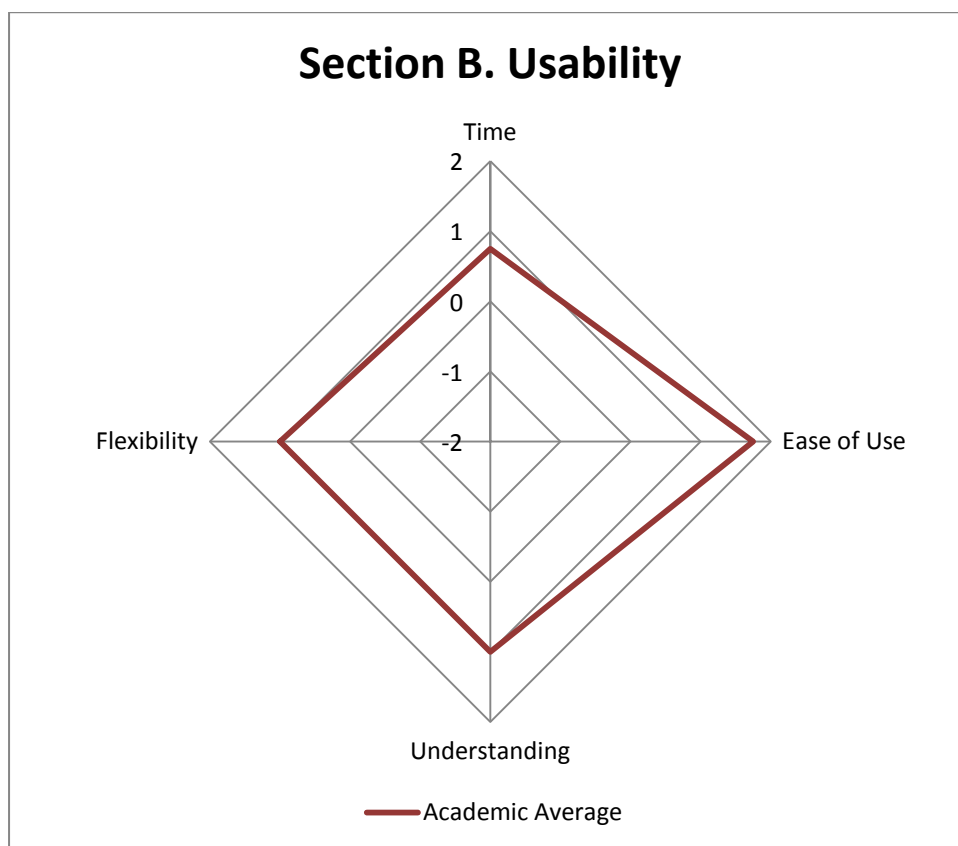


Figure 9-6. Section B - Usability : Academic Results

Important considerations that result from this stage of the evaluation are time, understanding, and flexibility, which have each received one zero score.

It can be seen in Table 9-5 and Figure 9-7 that the practitioner evaluators judged the PCRRM favourably across all areas of usability. The strongest areas being time and understanding of the methodology and the weakest the flexibility which scored on the negative side of the scale.

Table 9-5. Section B - Usability : Practitioner Results

Section B. Usability	A	V	Practitioner Average
Time	1	1	1
Ease of Use	0	1	0.5
Understanding	1	1	1
Flexibility	-1	0	-0.5

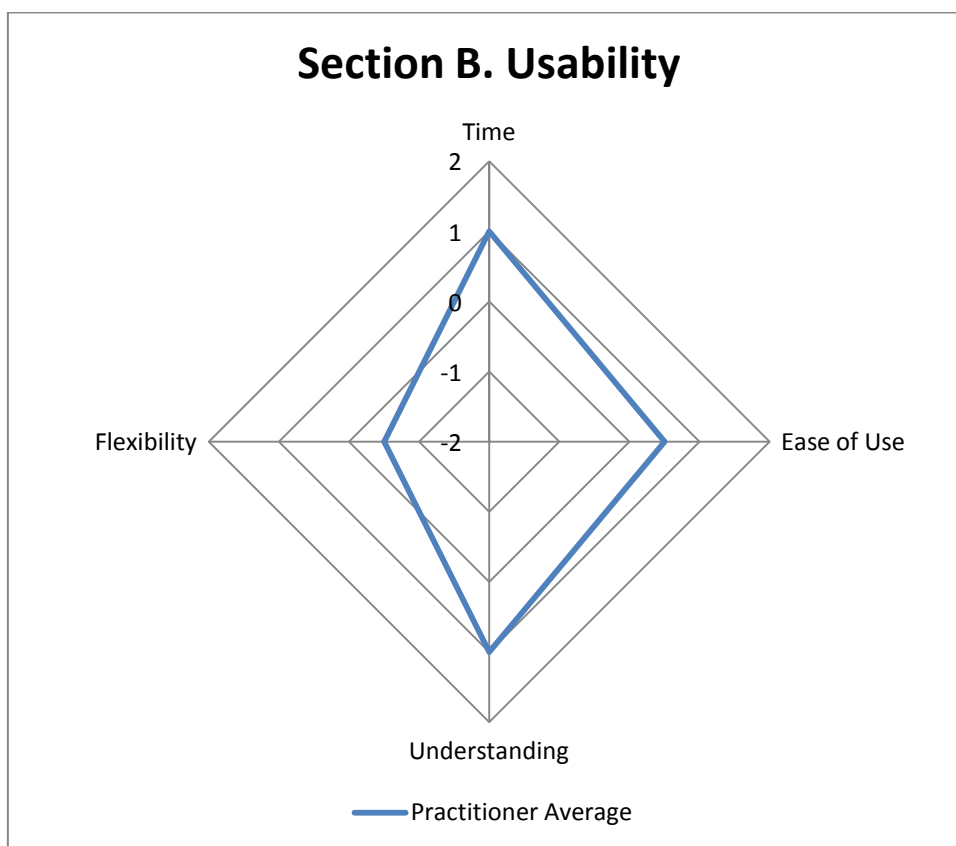


Figure 9-7. Section B - Usability : Practitioner Results

Important considerations that result from this stage of the evaluation are; ease of use and flexibility which have each received one zero score.

It can be seen in Table 9-6 and Figure 9-8 the combined average of both groups judged the PCRRM positively across all areas of usability. The weakest aspect being flexibility, although this area still scored on the positive side of the scale.

Table 9-6. Section B - Usability : Combined Results

Section B. Usability	Combined Average
Time	0.875
Ease of Use	1.125
Understanding	1
Flexibility	0.25

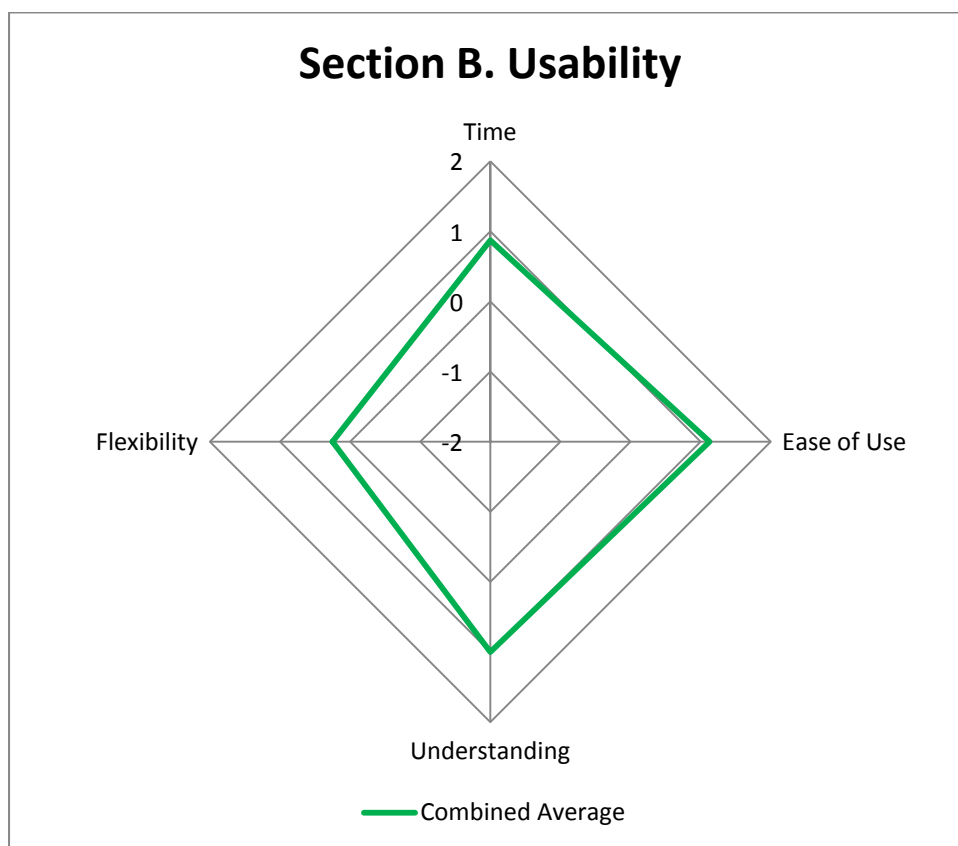


Figure 9-8. Section B - Usability : Combined Results

An important consideration that results from this stage of the evaluation is flexibility which received the least favourable scores from this section.

Usefulness

It can be seen in Table 9-7 and Figure 9-9 that the academic evaluators judged the PCRRM favourably across all areas of usefulness. The strongest area being the benefit of the methodology and the weakest being success, although even there the evaluators considered the methodology to be favourable.

Table 9-7. Section C - Usefulness : Academic Results

Section C. Usefulness	C	J	M	W	Academic Average
Efficiency	2	1	1	2	1.5
Satisfaction	2	1	1	1	1.25
Success	1	1	1	1	1
Practicality	2	1	1	2	1.5
Benefit	2	2	1	2	1.75

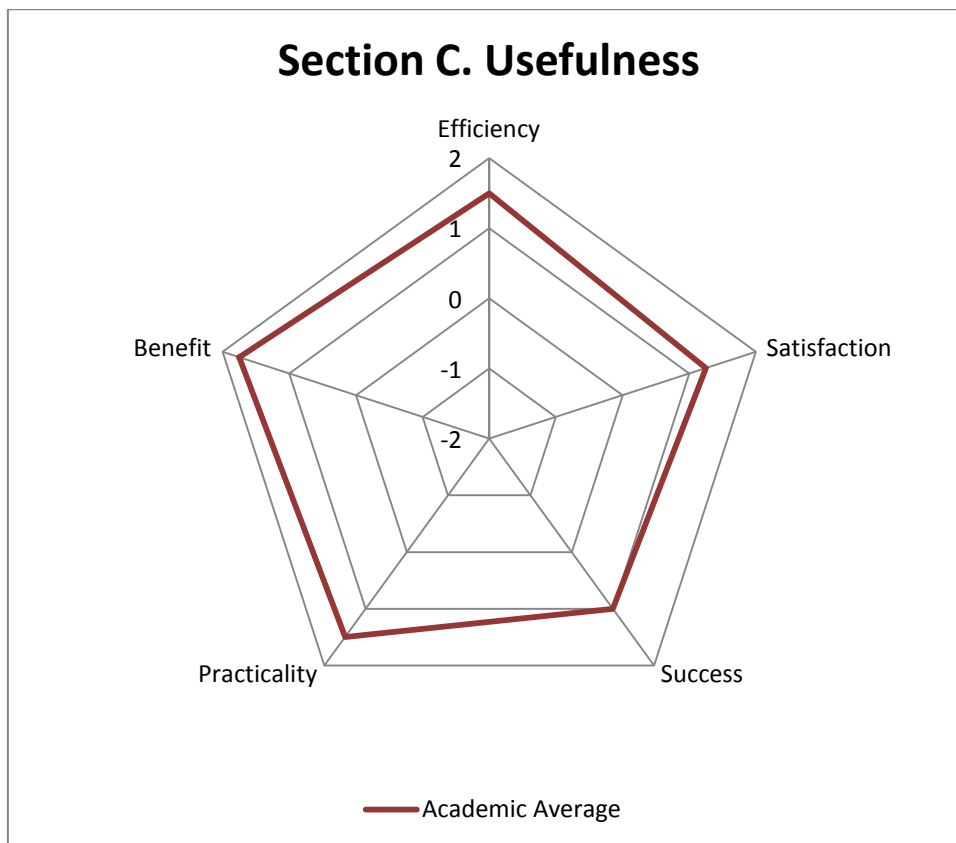


Figure 9-9. Section C - Usefulness : Academic Results

It can be seen in Table 9-8 and Figure 9-10 that the practitioner evaluators judged the PCRRM favourably across all areas of usefulness. The strongest areas being efficiency, satisfaction, and benefit of the methodology and the weakest being the success which still scored on the positive side of the scale.

Table 9-8. Section C - Usefulness : Practitioner Results

Section C. Usefulness	A	V	Practitioner Average
Efficiency	1	1	1
Satisfaction	1	1	1
Success	-1	2	0.5
Practicality	1	1	1
Benefit	1	1	1

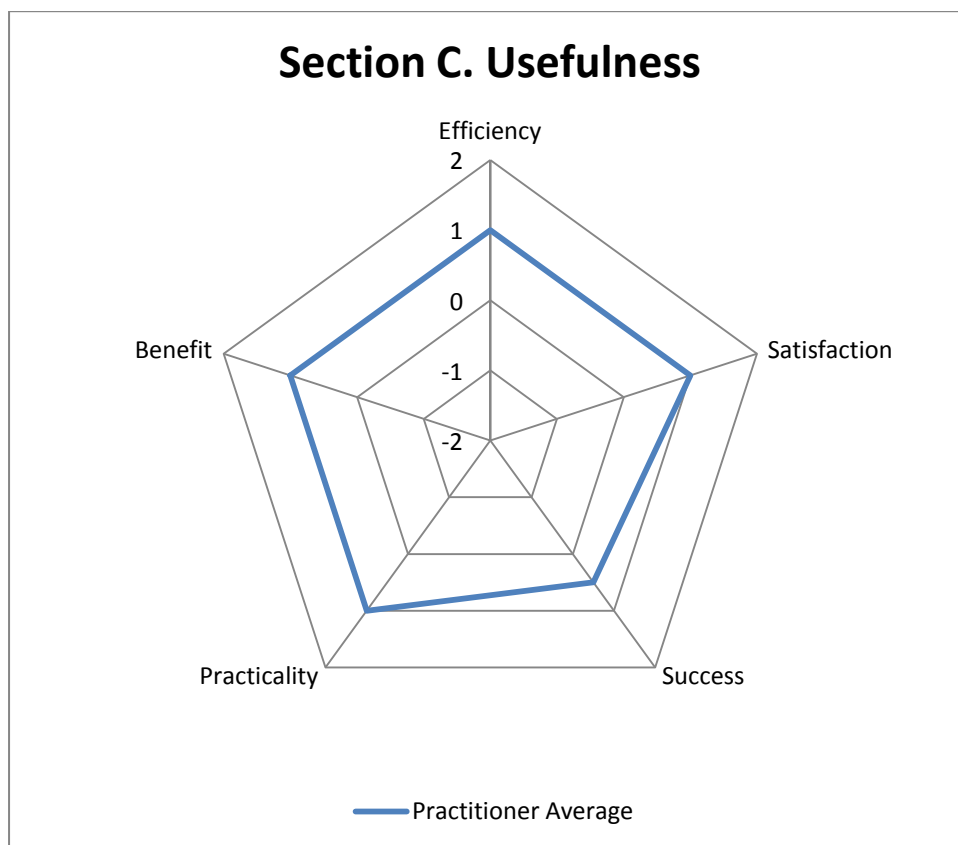


Figure 9-10. Section C - Usefulness : Practitioner Results

It can be seen in Table 9-9 and Figure 9-3 that the combined average of both groups judged the PCRRM positively across all areas of usefulness. The weakest aspect being success, although this area still scored on the positive side of the scale.

Table 9-9. Section C - Usefulness : Combined Results

Section C. Usefulness	Combined Average
Efficiency	1.25
Satisfaction	1.125
Success	0.75
Practicality	1.25
Benefit	1.375

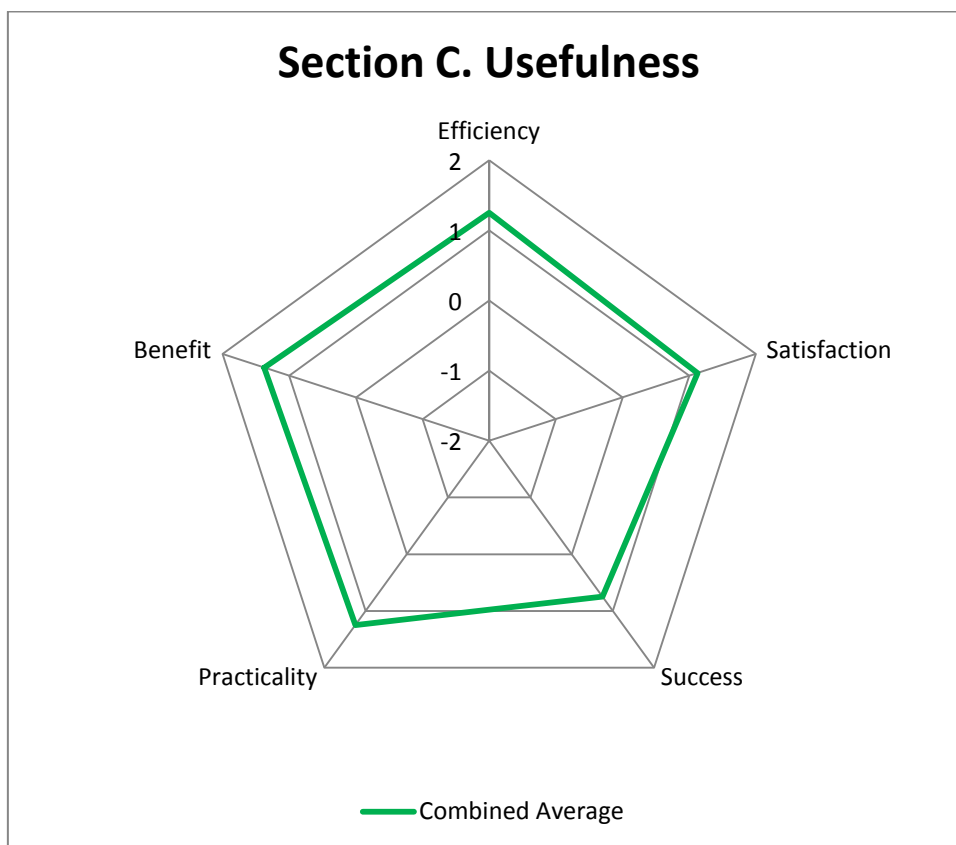


Figure 9-11. Section C - Usefulness : Combined Results

Modification

It can be seen in Table 9-10 and Figure 9-12 that the academic evaluators judged the inventory component to be the strongest element of the PCRRM, and CSR and acquisition weakest.

Table 9-10. Section D - Modification : Academic Results

Section D. Modification	C	J	M	W	Academic Average
CSR		1		-1	0.00
Acquisition	1	-	-1		0.00
Inventory	-1	-	1	1	0.33

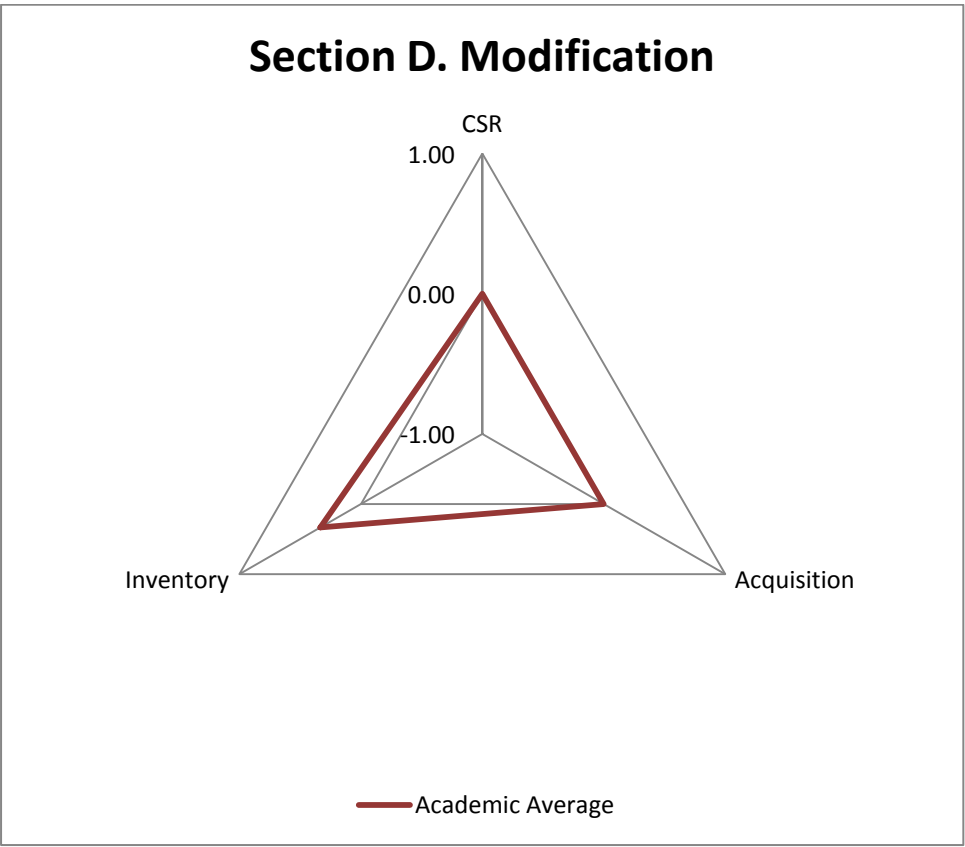


Figure 9-12. Section D - Modification : Academic Results

It can be seen in Table 9-11 and Figure 9-13 that the practitioner evaluators judged the CSR component to be the strongest element of the PCRRM, with acquisition and inventory the weakest.

Table 9-11. Section D - Modification : Practitioner Results

Section D. Modification	A	V	Practitioner Average
CSR	1	1	1
Acquisition		-1	-1
Inventory	-1		-1

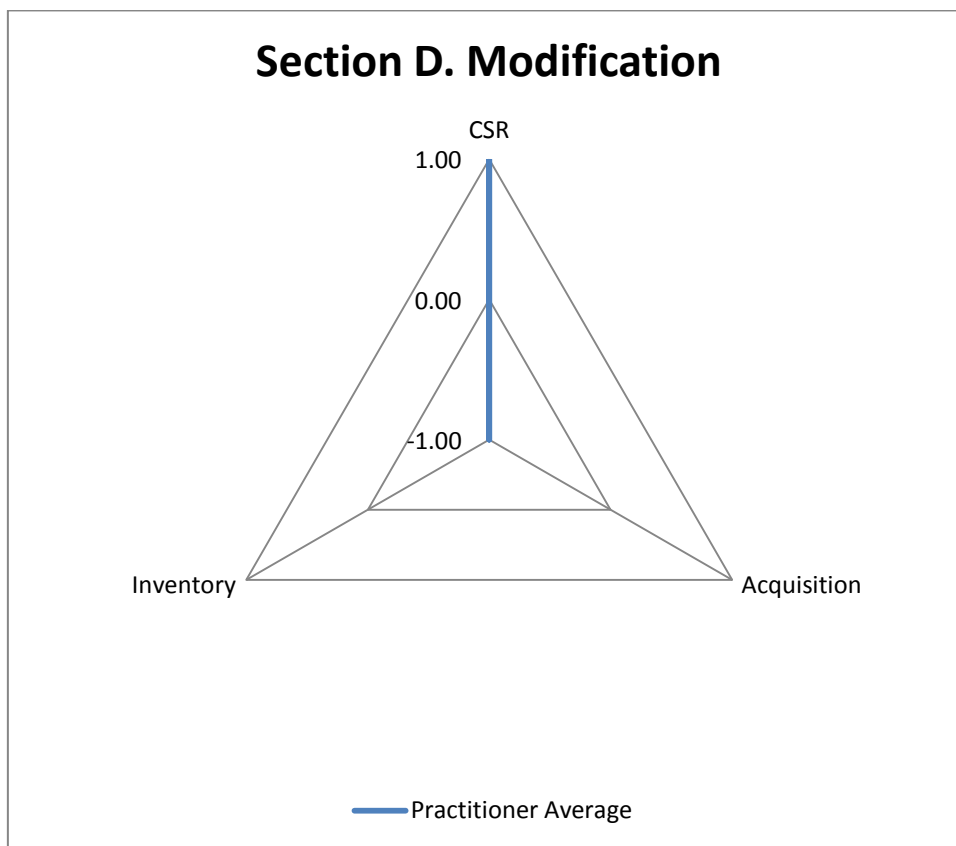


Figure 9-13. Section D - Modification : Practitioner Results

It can be seen in Table 9-12 and Figure 9-14 that the combined average for both groups of evaluators judged the CSR component to be the strongest element of the PCRRM, and inventory second, and acquisition third.

Table 9-12. Section D - Modification : Combined Results

Section D. Modification	Combined Average
CSR	0.50
Acquisition	-0.50
Inventory	-0.33

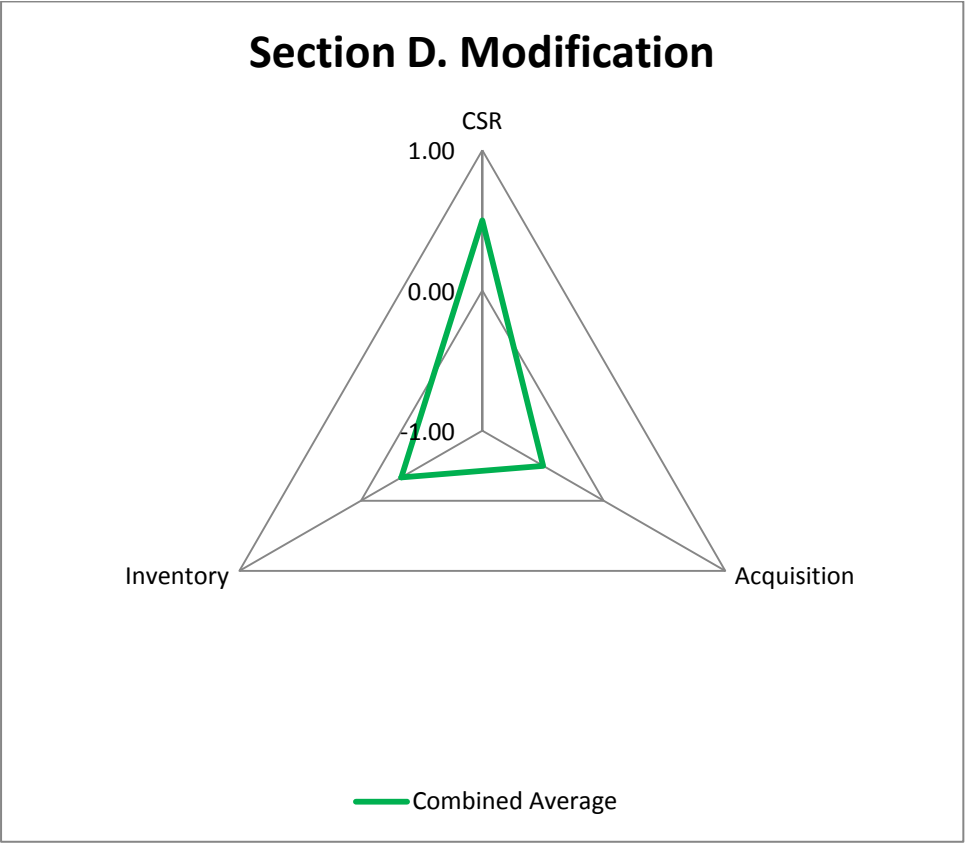


Figure 9-14. Section D - Modification : Combined Results

Design Features

It can be seen in Table 9-13 and Figure 9-15 that the academic evaluators judged the PCRRM favourably across all areas of design features. The strongest area being the structure of the methodology and the weakest being non-financial factors, although even there the evaluators considered the methodology to be favourable.

Table 9-13. Section E - Design Features : Academic Results

Section E. Design Features	C	J	M	W	Academic Average
Strategic Link	1	2	0	1	1
Core Activities	2	1	1	1	1.25
Holistic Approach	2	1	1	0	1
Non-Financial Factors	1	1	0	1	0.75
Initial Investment	2	2	1	-1	1
Continuous Improvement	2	2	2	2	2
Structure	2	2	2	1	1.75
Documentation	2	1	1	1	1.25
Tools and Techniques	2	1	1	1	1.25
Participation	2	1	0	1	1
Project Management	2	1	-1	2	1
Deliverables	2	1	1	1	1.25
Scope and Objectives	2	1	1	1	1.25

Important considerations that result from this stage of the evaluation are strategic link, holistic approach, non-financial factors, and participation, each of which has received one zero score.

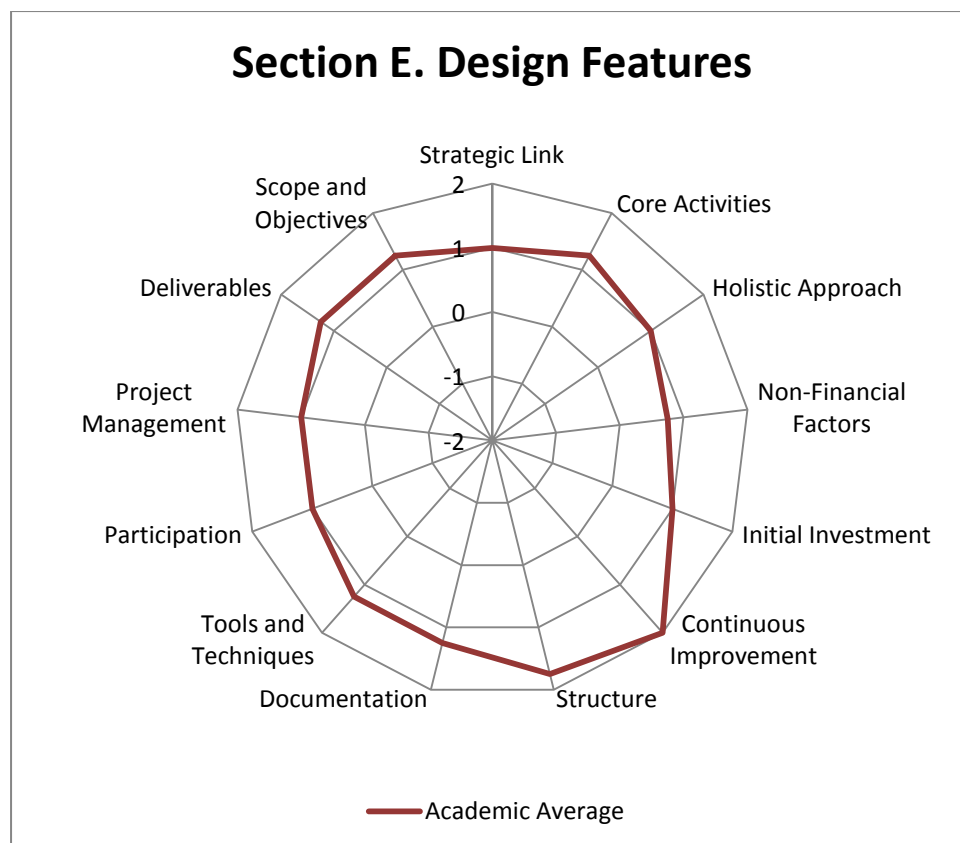


Figure 9-15. Section E - Design Features : Academic Results

It can be seen in Table 9-14 and Figure 9-16 that the practitioner evaluators judged the PCRRM favourably across all areas but one of the design features. The strongest areas being continuous improvement, deliverables, and the scope and objectives of the methodology. The weakest was judged to be the initial investment which scored neutrally on the scale.

Table 9-14. Section E - Design Features : Practitioner Results

Section E. Design Features	A	V	Practitioner Average
Strategic Link	1	1	1
Core Activities	0	1	0.5
Holistic Approach	0	1	0.5
Non-Financial Factors	0	1	0.5
Initial Investment	-1	1	0
Continuous Improvement	2	1	1.5
Structure	1	1	1
Documentation	1	1	1
Tools and Techniques	1	1	1
Participation	1	1	1
Project Management	1	1	1
Deliverables	1	2	1.5
Scope and Objectives	1	2	1.5

Important considerations that result from this stage of the evaluation are core activities, holistic approach, and non-financial factors, each of which has received one zero score.

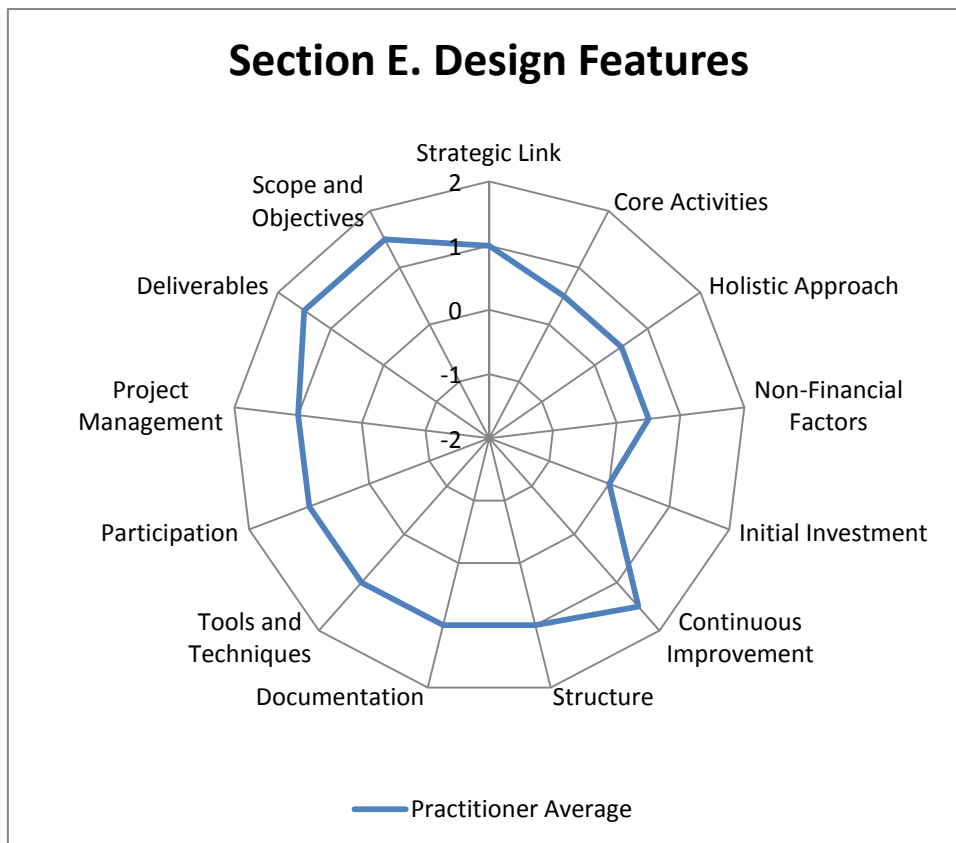


Figure 9-16. Section E - Design Features : Practitioner Results

It can be seen in Table 9-15 and Figure 9-17 the combined average of both groups judged the PCRRM positively across all areas of design features. The strongest feature was judged to be continuous improvement. The weakest aspect being initial investment, although this area still scored on the positive side of the scale.

Table 9-15. Section E - Design Features : Combined Results

Section E. Design Features	Combined Average
Strategic Link	1.00
Core Activities	0.88
Holistic Approach	0.75
Non-Financial Factors	0.63
Initial Investment	0.50
Continuous Improvement	1.75
Structure	1.38
Documentation	1.13
Tools and Techniques	1.13
Participation	1.00
Project Management	1.00
Deliverables	1.38
Scope and Objectives	1.38

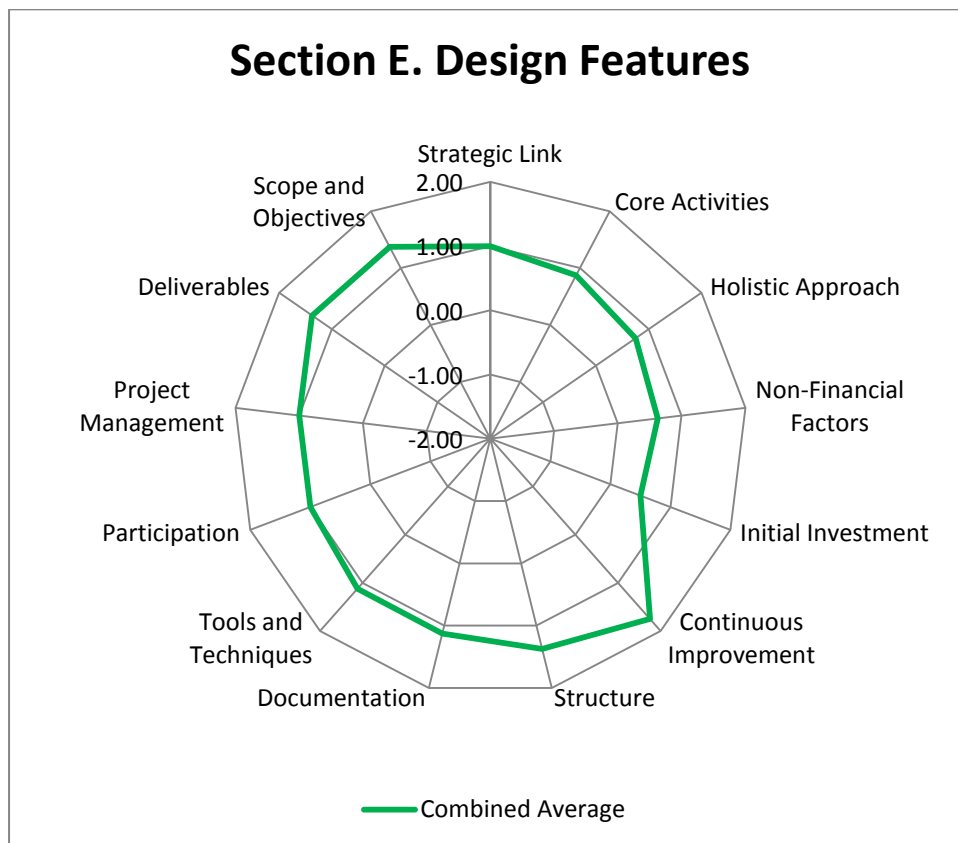


Figure 9-17. Section E - Design Features : Combined Results

All Sections and Final Scoring

Table 9-16 and Figure 9-18 show the average scores awarded by the academic evaluators for each main section of the evaluation questionnaire. It can be seen that all sections scored well into the positive side of the scale with section C (usefulness) judged most favourably.

Section D was not included here as the intention of that section of the questionnaire was to highlight the differences of evaluator perception of each study rather than the overall methodology.

Table 9-16. All Sections : Academic Results

All Sections	C	J	M	W	Academic Average
Section A. Feasibility	2.00	1.25	0.75	1.00	1.25
Section B. Usability	1.75	1.00	0.50	1.25	1.13
Section C. Usefulness	1.80	1.20	1.00	1.60	1.40
Section E. Design Features	1.85	1.31	0.77	0.92	1.21

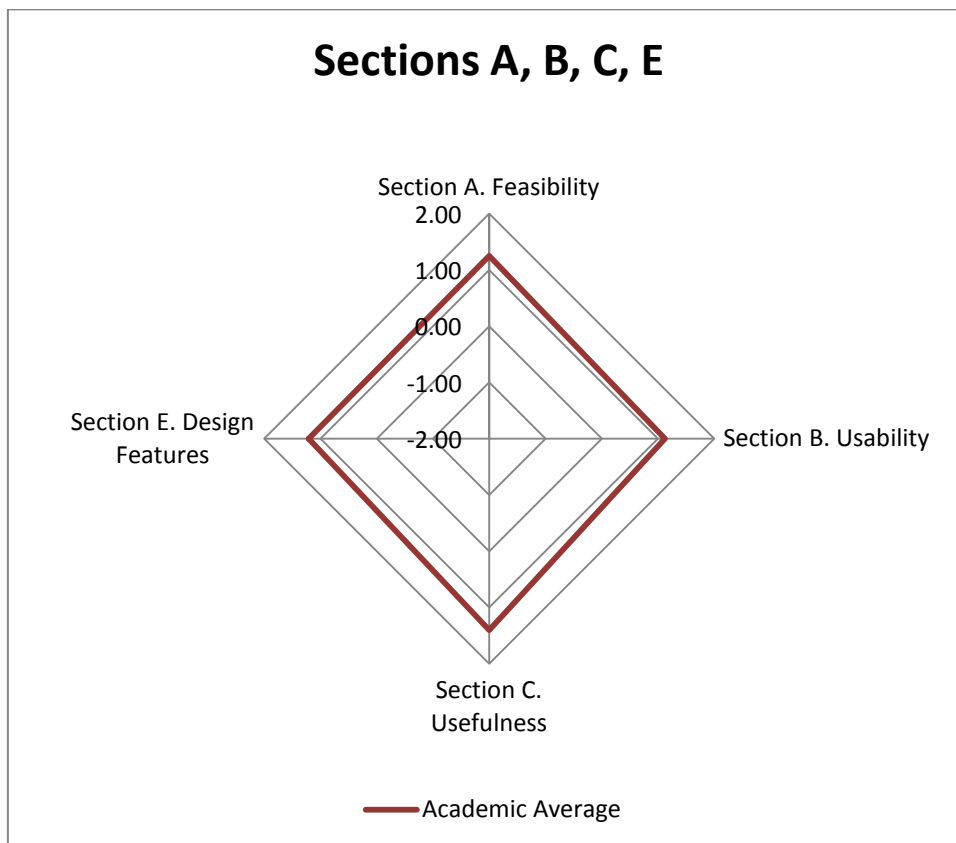


Figure 9-18. All Sections : Academic Results

Table 9-17 and Figure 9-19 show the average scores awarded by the practitioner evaluators for each main section of the evaluation questionnaire. It can be seen that all sections scored well into the positive side of the scale with section E (design features) judged most favourably.

Table 9-17. All Sections : Practitioner Results

All Sections	A	V	Practitioner Average
Section A. Feasibility	0.75	1.00	0.88
Section B. Usability	0.25	0.75	0.50
Section C. Usefulness	0.60	1.20	0.90
Section E. Design Features	0.69	1.15	0.92

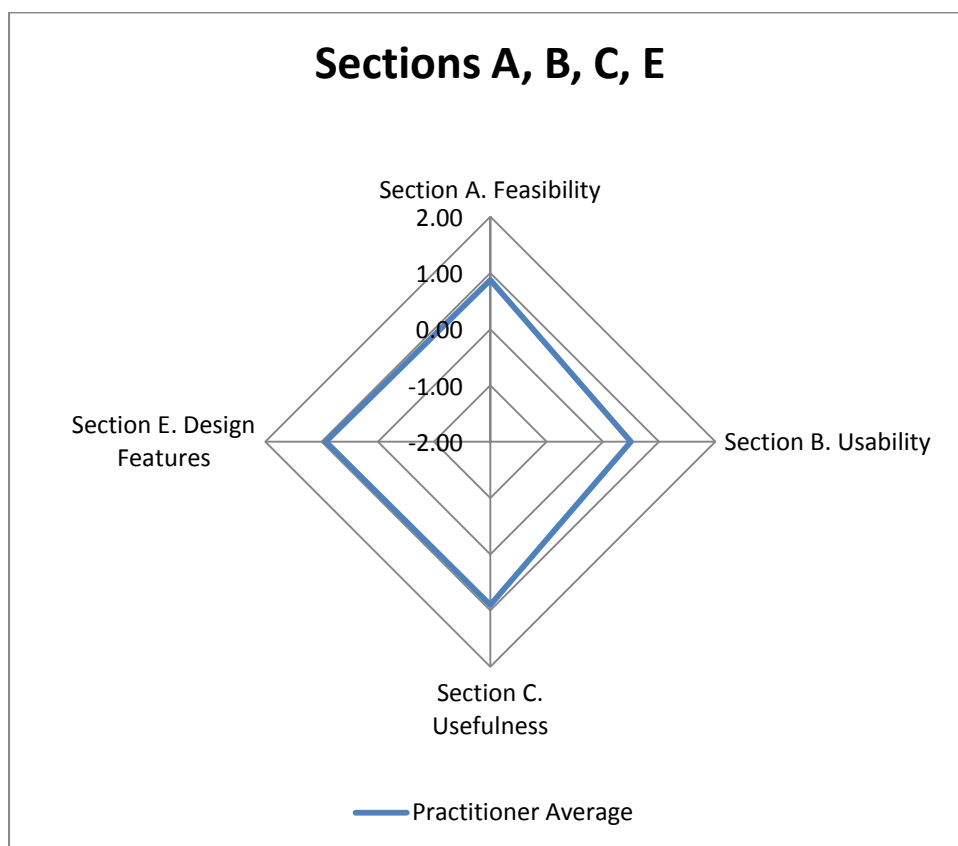


Figure 9-19. All Sections : Practitioner Results

Table 9-18 and Figure 9-20 show the combined average scores awarded the evaluators evaluators for each main section of the evaluation questionnaire. It can be seen that all sections scored well into the positive side of the scale with section C(usefulness) judged most favourably.

Table 9-18. All Sections : Combined Results

All Sections	Combined Average
Section A. Feasibility	1.06
Section B. Usability	0.81
Section C. Usefulness	1.15
Section E. Design Features	1.07

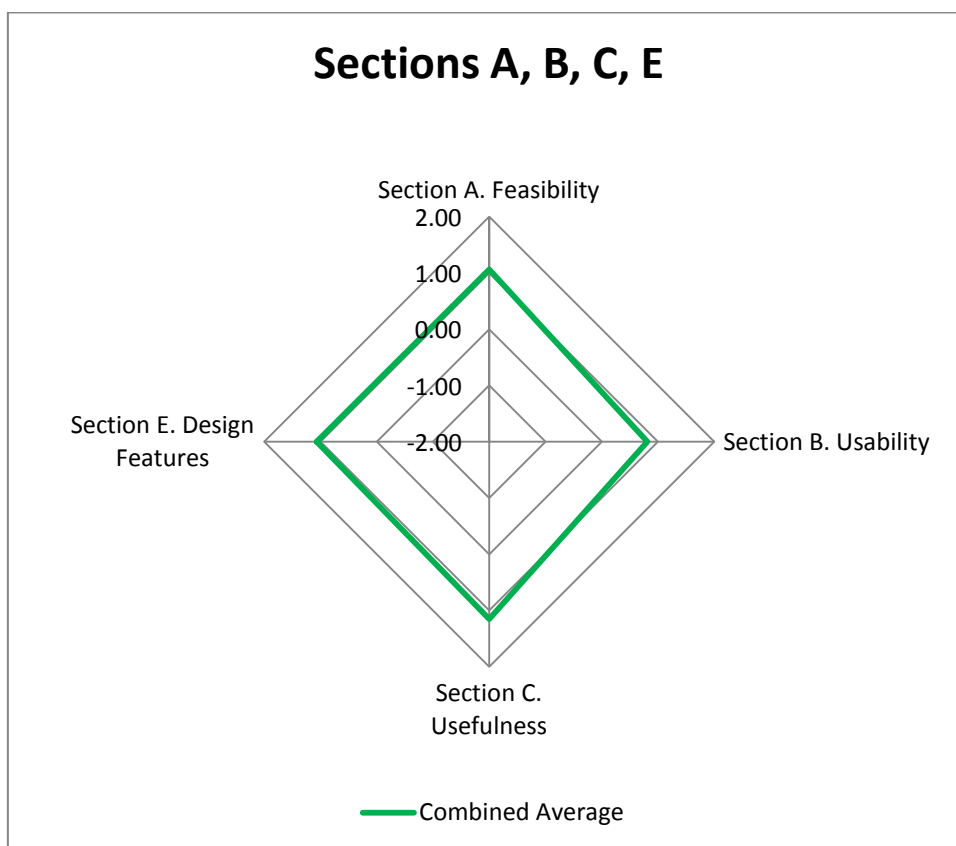


Figure 9-20. All Sections : Combined Results

Table 9-19, Figure 9-21, and Figure 9-22 show the final assessment by academics, practitioners, and then their combined judgement for the PCRRM as gathered through the evaluation questionnaire. The two approaches shown consider firstly the final scoring when using the scoring for each question equally (score by question, Table 9-19), and secondly when using the scoring for each section equally (score by section, Table 9-19). The two approaches result in very similar final scores in all cases. On average, the academics have assessed the PCRRM more favourably than the practitioners, although both groups have scored the PCRRM well into the positive side of the scale.

Table 9-19. Final Scoring

Total	End Score by Question	End Score by Section
Combined	1.04	1.02
Practitioners	0.85	0.80
Academics	1.24	1.25

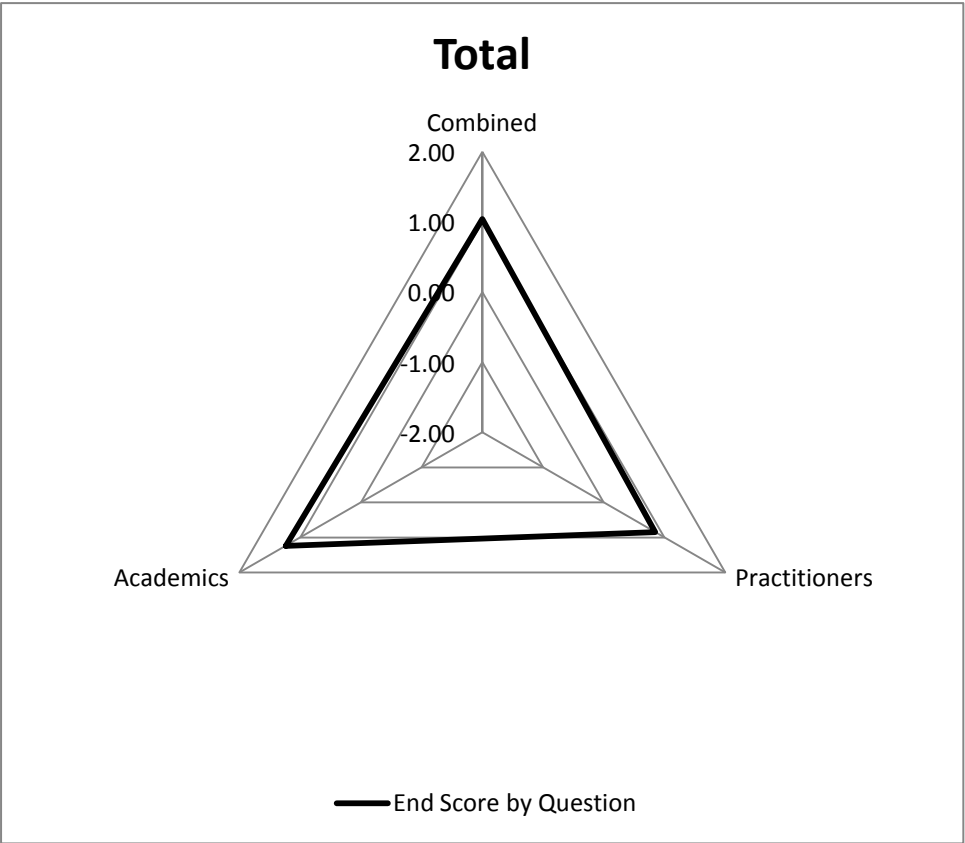


Figure 9-21. Final Scoring by Question Average

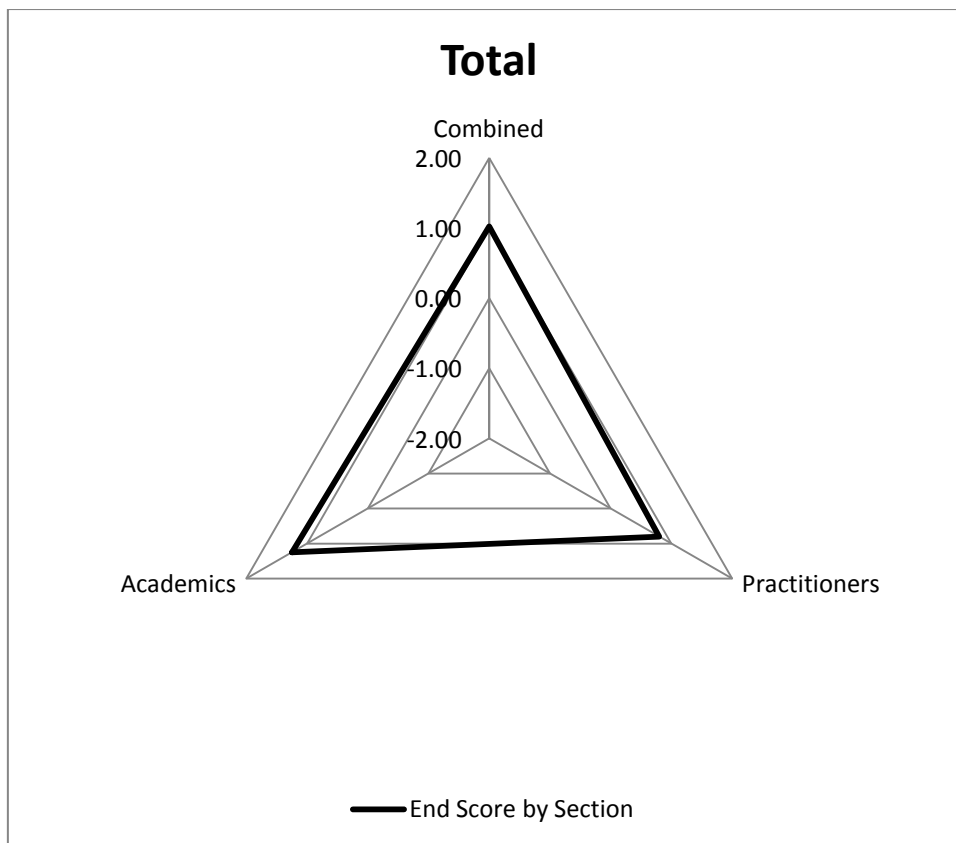


Figure 9-22. Final Scoring by Section Average

Qualitative results

In addition to the quantitative results gathered through the evaluation questionnaire, the author gave participants the opportunity to offer open comments about any aspect of the PCRRM. This subsection details the pertinent qualitative data recovered through this process.

Academic 1 (C)

- *Time: will improve further over time with company familiarisation*
- *Success: could also build in feedback to company policy/guidelines*
- *Best component: Acquisition, reduces price fixing deals, helps to establish true market rate*
- *Worst component: Inventory, more difficult to implement, could be more difficult to implement than other two due to company stock controllers vs. maintenance staff conflict risk*
- *Comments (components): there needs to be a feedback from this work into the company policy, e.g. production of guidelines on how to do business with company (given to suppliers) drawn from CSR, and from policy/strategy into the methodology, so it can adapt over time, could be suggested as further work (future research) in thesis*

Academic 2 (J)

- *Applicability: maybe it could be applied to other industrial domains not only automotive*
- *Efficiency: use of excel as a tool proved useful*
- *Best component: CSR. Supplier evaluation process is useful for scoring suppliers based on general criteria*
- *Any other comments: it would be useful to apply this methodology to their sectors and their supplier chains to see if it would also be valid*

Academic 3 (M)

- *Time: risk involved with 3rd party lag time (waiting forever)*
- *Ease of Use: seems to be a well developed set of tools using established software (Excel etc)*
- *Understanding: each individual component is clear*
- *Flexibility: yes in that tools themselves are flexible, each component looks to be sufficiently decomposed as to allow flexible alteration without such rigidity that the whole thing collapses, possibly no simply because after roll out, how realistic would it be to go back to companies and suppliers to present a new methodology*
- *Efficiency: doesn't seem to require many resources (money, men), only time being the main issue*
- *Satisfaction: reasonable savings, and risk assessment*
- *Success: meets/combats each component very well*
- *Practicality: trial success points to this*
- *Benefit: not much stick and enough carrot*
- *Best component: Inventory, good, clean, efficiency, and logical approach to tracking success*
- *Worst component: Acquisition, only possible if there is a basis for some of the unknown information on a extrapolated average risky*
- *Structure: very well structured*
- *Tools and Techniques: through feedback from 3rd parts, may be a time issue*
- *Project Management: not sure I agree, seems more appropriate for a company level wide approach*

- *Any other comments: very well structured methodology, with what would seem a fully fleshed set of supporting tools, the trials seemed successful and the methodology itself already looks to be having an impact*

Academic 4 (W)

- *Contingency: the question encompasses too wide an area*
- *Best component: Inventory, clear, short path to “saving money” (project aim)*
- *Worst component: CSR, distant link to “saving money”*
- *Strategic Link: CSR identifies suppliers that support strategy*
- *Holistic Approach: I lack expertise to judge*
- *Non-Financial Factors: CSR seems to be non-financial*

Practitioner 1 (A)

- *Completeness: method works, always going to get something specific that is difficult to plan for*
- *Consistency: Comments: Broadly speaking yes, investigation, data analysis, proposal etc*
- *Contingency: I think options are limited, ultimate decision is, develop current supplier or re source*
- *Time: once set up, operationally the time should be a fraction*
- *Ease of Use: with practice, I found CSR hard work at first to understand, familiarity with practical use*
- *Flexibility: it seems bespoke for each specific element*
- *Efficiency: especially in early stages*
- *Success: the project did not take account of the admin cost to re source a slow moving part*
- *Best component: CSR, set the standard to review how suppliers are measured*
- *Worst component: Acquisition, would be good to build in a usage indicator where slow moving stock up to a certain total value is overlooked due to the admin cost to actually do something with that*
- *Strategic Link: should be used in the decision making process*
- *Initial Investment: I think that the first effort would take time to gain the knowledge and be comfortable with the data*

- *Continuous Improvement: already has, CSR, for example*

Practitioner 3 (V)

- *Applicability: Some tailoring may be necessary depending on the required outcome/focus*
- *Ease of Use: Agree as a general principle. The matrix used for recording supplier CSR responses is not easy to understand the first time it is seen and requires some explanation.*
- *Flexibility: This has only been viewed from Toyota's required application*
- *Best component: CSR, This was a area new to the user and the company had no experience on how to approach the component*
- *Worst component: Acquisition, This was the component the company had more experience with and some of the methodology was already used but perhaps not documented in the same way*
- *Comments (components): The CSR tools are still used although modified. The scoring system gave poor results where some of the elements were not applicable*
- *Tools and Techniques: Some tools and techniques were not known to some individuals and the opportunity was taken to increase their knowledge in the use of the tools and techniques*

9.6 Discussion

This section brings together the quantitative and qualitative assessment of the PCRRM developed through the evaluation questionnaire process and analyses what these mean for the thesis contribution and its limitations.

In general terms, it was found that the academic evaluators favoured the PCRRM over their industrial counterparts. Both groups scored the methodology favourably across all sections and the average rating of the validity of the PCRRM was positive. However, across most areas the practitioners did not respond as positively to the proposal and gave consistently lower (although still favourable) scores. There are a number of reasons why this is to be expected. Firstly, the academics are more conversant in assessing methodologies. In particular, the Manufacturing Department of Cranfield University is a strong contributor to the body of research in this area. Practitioners may not have understood all of the requirements of a good methodology and instead assessed the proposal based on a narrower world view. In addition, the academic panel of evaluators was double the size of the practitioner group, reducing the ability of outlying scores the influence to overall average. However, the practitioner participants were as accepting of the proposed methodology as the academics were. This difference is important to recognise, and in conjunction with some of the qualitative findings, has informed the PCRRM to ensure that the

areas of concern are redrafted and given greater clarity. It is the opinion of the author that the largest disparity in assessment between the two groups can be attributed to expectations and outcomes. Having conducted the component studies in the same industrial environment, it is clear that the PCRRM when presented as a holistic methodology was favoured less well than when each component was implemented individually. This issue will be discussed at greater length in the final analysis of the thesis in the chapter that follows. The results of this validation indicate that the delivery of the PCRRM to the practitioner community requires greater clarity than was available during this process of evaluation, in order to ensure that every positive facet of the methodology is explained and communicated.

Critical to the success of this validation process has been the establishment of the evaluation panel. The first major concern the author had in establishing this panel was the difficulty any group of individuals would have in providing a thorough and insightful evaluation of the work. Previous experience of the author had shown that even under ideal conditions with plenty of pre-planning and preparation time, an audience can have difficulty getting to grips with all of the most important aspects of a piece of research. To meet this head on, the author put together an evaluation pack which consisted of all of the materials available in the PCRRM, along with selected process flows and figures from the thesis. This pack in conjunction with the presentations made to each group of evaluators proved to be a valuable tool in ensuring that both groups were provided with all of the information they would need to support their evaluation. Two groups required different levels of support through the presentation of the PCRRM. In simple terms, it was found that the practitioner's strengths lie primarily in understanding how the PCRRM would operate at the implementation stage. In contrast, the academics were found to be much more able to place the PCRRM in context as a methodology, but were less certain about detailed implementation issues. This difference was expected and anticipated, and in a sense strengthens the idea of using both sets of evaluators in order to establish the complete and fairest means of assessment. The questionnaire delivered to both groups was identical. This made the processes of questionnaire and assessment design more difficult, as the needs of both groups were taken into account. Different questionnaires would have resulted in a disjointed and immeasurable disparity in results this would at worst have made the validation of the PCRRM weaker. The positive outcome from designing the process in this way is to have an easily comparable catalogue of measures, against which the author can identify strengths and weaknesses. It is important to note however that differences in measure between the groups do not necessarily relate to a failing on the part of either the PCRRM or the evaluation protocol. The consideration here was time versus resource quality of versus results. In total, the

six participants in this validation have provided a depth of analysis that would have been reduced if many more were involved, and a breadth of analysis that would have been constrained should significantly fewer had taken part. The calculation on the part of the author, supported by the academic supervisor, was that between five and ten participants would result in a comprehensive evaluation, while maintaining manageability and an effective use of resources. This decision was supported by the historical success of similar validation processes run in the Manufacturing Department of Cranfield University, such as those of Vergidis (2008).

Both groups of evaluators responded positively across the majority of criteria. These criteria were intentionally designed to be as rigorous as possible, while allowing the process to be conducted in a reasonable time frame. This gives a high level of confidence that the results presented in this chapter are well supported. Another positive result from this process is the additional layer of confirmation that has been described by including two distinct but important expert groups in the evaluation. In doing so, the author has been able to ensure that the validity of the PCRRM is supported.

Some of the most interesting outcomes from this process have been the qualitative information collected from both groups. In designing the questionnaire, the author made sure of leaving space for participants to provide insights and feedback, wherever possible.

In establishing and implementing this process of evaluation, it has been possible to show that the methodology proposed in this thesis and been developed in accordance with the expected level of rigour and objectivity required of a research programme. It has also been possible to show that the PCRRM has in its final form met the research objectives of a skeleton methodology for strategic purchasing, and in doing so supported the wider research aim of developing a novel methodology for identifying and implementing cost reduction activities for the purchasing function of automotive companies. The focus here is on continuous improvement in the purchasing process, including costing, sourcing, stocking, and social responsibility assessment.

9.7 Summary

This chapter presented the results from the final stage of validation for this research programme. Chapters 6, 7, and 8 each produced their own validation stream at the component level, based upon real world results from each of the study's implementations in the sponsor company's live environment. This chapter has set out the higher level validation which focused on the Purchasing Cost and Risk Reduction Methodology (PCRRM) as a holistic programme of actionable techniques.

The process evaluated the PCRRM as a methodology using two groups of evaluators. The author began by identifying the core attributes that a validation focusing on a methodology should have and then developing the materials and process to support this stage of research. Academics with experience of methodological development and research skills were used alongside experienced purchasing professionals working in a large automotive manufacturing company. These two groups used a structured evaluation protocol to assess each aspect of the PCRRM as well as providing additional comments and insights into the relative strengths and weaknesses of the proposed methodology. This process of validation was carried out to give an additional layer of appraisal to the results found during the implementation of the PCRRM components (as described in earlier chapters). Taken together, these two layers of validation provide a comprehensive evaluation of the PCRRM and its components, by demonstrating that the output from this research programme has been tested both in the live environment with real data and resources, alongside a more traditional

The next and final chapter of this thesis gives an overview of the research, from conception to validation, and gives a critical analysis of the contribution to knowledge that this programme of research has made. In addition, the reader will find a number of acknowledged limitations identified through the validation presented in this chapter and through the three previous component level validations made through Chapters 6, 7, and 8.

Chapter 10

Discussion and Conclusions

10.1 Introduction

This chapter concludes the thesis with a discussion of the findings made throughout the research programme and case study investigations. This chapter also identifies the key contributions to the body of purchasing and supply management knowledge which have been made in completion of this thesis. Finally, the limitations of the research and proposals are discussed, and the future research options and opportunities are presented.

10.2 Chapter Structure

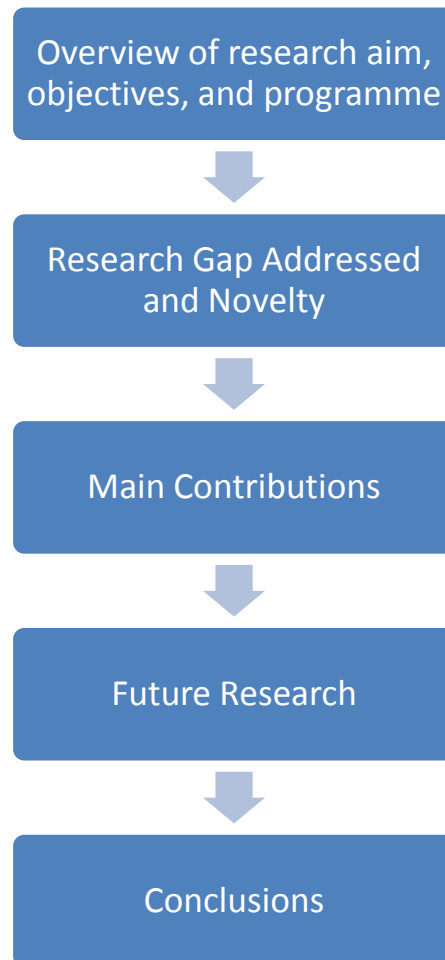


Figure 10-1. Chapter structure

10.3 Overview of research aim, objectives, and programme

This section provides an overview of the research aim, objectives and research programme.

The issues identified in the literature and from investigations of the challenges facing practitioners in the field was distilled into a single research aim with supporting objectives. The aim of this research was to:

“Develop a novel methodology for identifying and implementing cost reduction activities for the purchasing function of automotive companies. These activities will implement continuous improvement in the purchasing process, including costing, sourcing, stocking, and social responsibility assessment.”

To realise this aim, the following objectives were identified and executed:

1. Explored how strategic purchasing is implemented in the field and identify the key issues facing practitioners.
2. Provided a representation technique for the identification of price reduction candidates and the comparison of dissimilar supplier bids.
3. Captured the social responsibility competency of the supply base and provided a formal means of measuring and reporting supplier compliance.
4. Provided a representation technique for the identification of stock reduction candidates and investigate the use of supplier knowledge in stock reduction.
5. Designed a skeleton methodology for strategic purchasing that assimilated the results of Objectives 2 to 4.
6. Validated the research results within the purchasing environment of the industrial collaborator (Objectives 2-4) and through structured interviews (Objective 5).

A 4 step research programme was designed and executed to realise the research aim and objectives. The steps of this programme were are shown in Figure 10-2.

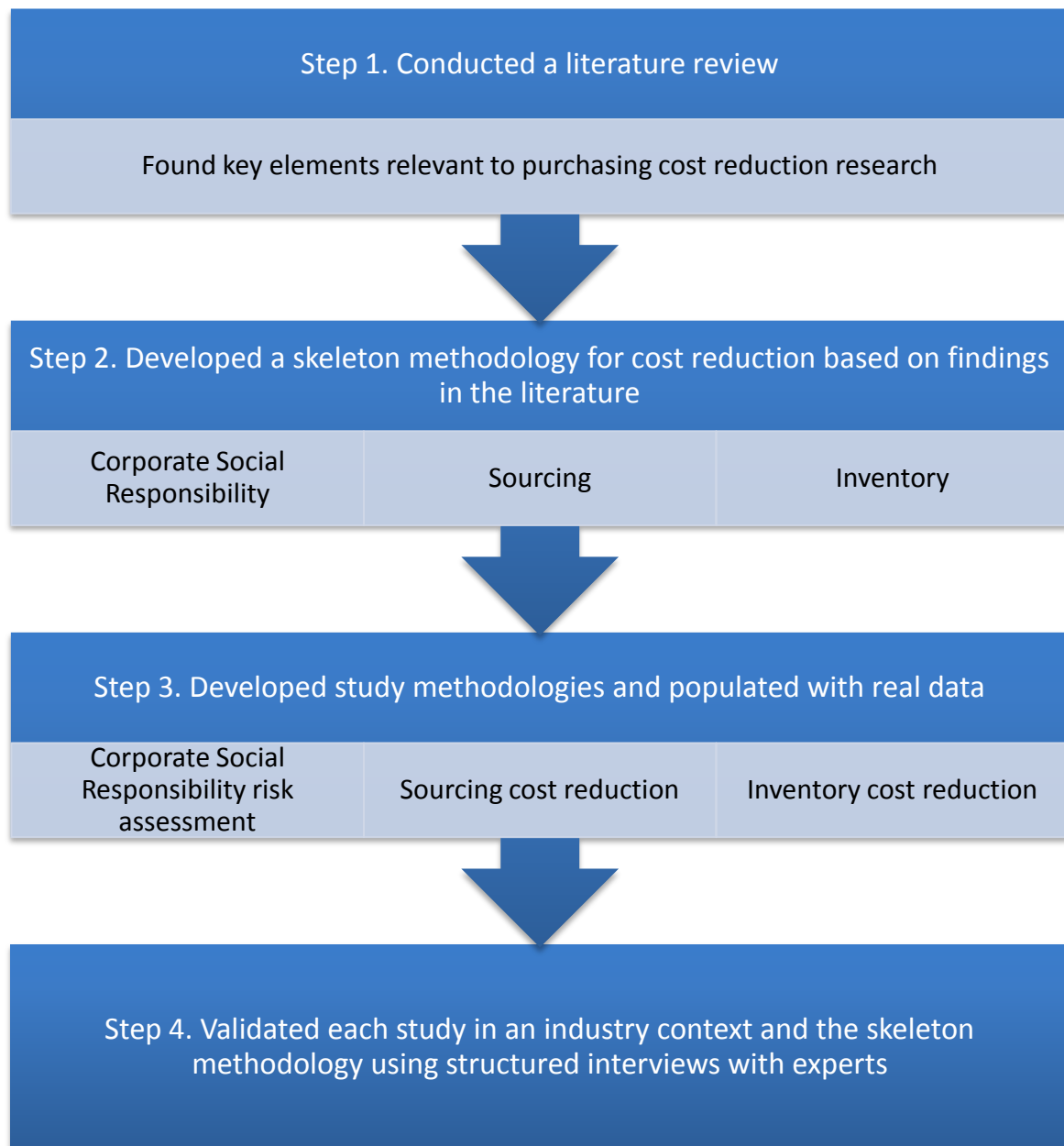


Figure 10-2. Research process flow

10.4 Research Gap Addressed and Novelty

The body of research contains a number of contradictory, overlapping, or inconsistent uses of terminology which have hindered previous attempts to tackle the issues of cost and risk reduction. Many of the approaches used by the research community are not accessible to industrial practitioners, as they lack the specialist research training to be able to decode the frequently complex tools and approaches proposed. It is paramount that any approach to cost and risk reduction in the purchasing and supply management field be made with particular consideration to this issue. In addition it has been found, through the use of a theoretical classification, that the field of purchasing and supply management has expended over the last ten

years to include a number of satellite disciplines. The classification technique enabled the author to identify areas of key importance and topics which were under studied or had not been taken into consideration by other methodological proposals. There is a distinct need in the field for a holistic methodology which can bring together the academic rigour of the body of research, the practicability of industrial specialists, and new findings based on previously under studied case study scenarios. There is currently no methodological proposal that has assimilated these requirements. All previous attempts to provide such a solution have resulted in overly burdensome and unrealistic methods which are not implementable in a live environment. The work proposed in the literature is fragmented.

The novelty of this research is to identify develop a holistic methodology to identify and reduce costs and risks in the purchasing and supply function of a large automotive manufacturing organisation. This research has brought together the concepts of corporate social responsibility risks management, strategic sourcing for purchasing cost savings, and supplier partnering to reduce inventory levels and post purchasing costs.

10.5 Main Contributions

CSR

The participant selection identified which suppliers should be assessed using the CSR evaluation questionnaire. This is an important component in the overall process because it would not have been feasible to evaluate the sponsor company's sizeable supply base in full. Identifying 20 suppliers for evaluation was essential as the attrition rate was unknown and estimated to be sizeable. The CSR evaluation process identified which suppliers should be considered for CSR audit. This process is significant because it gave the purchasing manager an objective basis for decision making. The main features of this study were:

- The questionnaire developed and deployed online allowed for a quick dissemination of questionnaires as well as responses. It also allowed the tracking information. This was useful in chasing up responses and offering help to any respondent who might be facing technical difficulties. Using tracking data also makes the process of evaluation much more straight forward as it removed the possibility of missing responses.
- The five sections used to group together questions in the questionnaire reflected the major CSR competency areas.

- The design of the questions makes the process of completing the questionnaire as straight forward as possible for the respondents, whilst also ensuring that sufficient data on their CSR competencies could be gathered.
- Using a large number of yes/no questions along with lists made analysis easier.
- The evaluation process was designed in a way that made it both robust and possible for the employees of the sponsor company to be able to implement future iterations in a seamless manner.
- The scoring of questions was kept to a simple points awarding system. This gave a clear indication of whether a competency had been identified and makes it relatively straightforward to use the figures in automated calculations without the need to make complicated adjustments. The scoring process made it simpler for the users to understand and the results easier to adjust in the future.
- The weighting mechanism establishes the local results from each section of the questionnaire establish a final and total evaluation of each supplier.
- Each of the five sections investigated different aspects of the suppliers' competencies.
- The grading of supplier competencies was the final stage in the evaluation process and was designed to be as automated and efficient as possible. The setup values of the grading make it possible to adjust the calculations and grading of each section as required.
- The evaluation tool brought the stages of evaluation into one place making it easier for the users to make adjustments to its functionality without the need for advanced software development skills.
- Colour coding the questionnaire sections made the task of assessing the responses clearer and less likely to suffer from human error. The colour coding of the sheets and columns was kept consistent throughout to ensure that the users could more easily work the results of the questionnaire and the evaluation tool.
- The summary sheet gave a one page summary of the evaluation process. Using this sheet the purchasing manager could see how many suppliers had completed the process, how each of the respondents had scored in each of the key CSR competency criteria, how each section was weighted and graded, which suppliers were current candidates for audit, and most crucially why they were candidates.
- The dual scoring and grading system gave the purchasing manager scope to use the results in different ways. Internally, the purchasing manager could communicate the results using the O/ Δ /X and externally the numerical scoring is useful.

Sourcing

Japanese parts were found to be a substantial input into the sponsor company. The extended supply route for these parts makes them a prime candidate for resourcing activity. In addition, the threshold of data and justification required to progress this programme of work demonstrated how a less disciplined process could have become derailed. The comparison of prices paid in the UK compared to those in Japanese domestic market demonstrated that this was an area of critical importance. The study showed that part number alterations are a key reason for the lack of standardisation as they are almost always untracked and result in higher prices due to suppliers over pricing. Suppliers were found to be unhelpful in tracing through these issues and worked against the best efforts of the author in developing a process for standardisation and cost reduction. The use of 'virtual baskets', showing the relative performance for each of the suppliers against current spend, has allowed the specialist within the purchasing department to compare across suppliers and parts where direct comparison is not possible. The case study resourced parts based on a fair approach to supplier negotiations. It was found that, where price increases were accepted in some instances, suppliers were more open to considering price reductions in others. This component of the PCRRM will over time re-source business to a single competitive supplier and in doing so corporate services will be better able to manage part-supplier-manufacturer relationships. Suppliers were incentivised to maintain/offer competitive prices in order to retain/gain business. The process of managing price changes is now more transparent and future negotiations for re-sourcing simpler. The study demonstrated how using 'virtual baskets' at the competitive bid stage can allow a manufacturer to compare the relative performance of its supply base, even where there is a lack of direct competition on a part by part basis. The main features of this study were:

- The supplier tenders were consolidated into a single point for easier calculation and cross-referencing, this made the task of comparison straight forward and displayed the missing pieces of the submissions on a single worksheet.
- The prices were converted into Sterling using an agreed conversation rate. It was necessary to align all tenders in a fair manner that made it clear what the final quotation was for each part. If this had not been carried out the analysis and recommendations would have been built on moving targets, depending upon exchange rate movements.
- The graphing of the quotations was carried out to visually demonstrate the positive or negative outcomes from the quotations process.
- The table summaries were used to give the Purchasing Manager an executive summary of the findings of the trial and show where possible savings may be achievable.

- Conducting the analysis in this way made it possible to give a fair assessment of a supplier's general cost reduction across parts, despite there being differences in the combinations of parts being quoted for.
- The final steps in this phase were to generate a proposal for resourcing and provide an estimate for the cost savings that this proposal would generate.
- The rationale for the recommendation was that at the macro-level the sponsor company was set to appreciate an overall reduction in costs. At the micro-level, it demonstrates that the sponsor company is willing to redistribute business to compensate for losses in other areas.
- The final stage of the process was to estimate the cost savings projected over a one year period based on historic usage of the parts analysed and resourced. This was carried out to allow management to see that the process was set to deliver significant percentage and real savings.

Inventory

Assessing the candidate machine spare suppliers in a structured form is based on the criteria found in the literature and assists purchasing specialists in addressing the practical difficulty of choosing an appropriate partner. The inventory case study resulted in the development of a set of criteria that purchasing managers can use in order to assess potential partners. The work improves the basis for a crucial decision taken by specialists in the purchasing and supply management field. This component of the methodology allows for the gathering, analysis and synthesis of data required to identify partner suppliers.

The questionnaire design allows the practitioners to find out what specific engineering knowledge the supplier has and relates to the particular manufacturing and MRO requirements of their companies.

Using solely historical purchasing transactions and an internet search, suppliers can appear to be appropriate candidates for this work. However, when using the structured questions of partner selection questionnaire, unsatisfactory scores can be attained. This confirms that this approach yields quick and useful results for purchasing practitioners. Other suppliers are quickly eliminated at the early stages, saving time and money.

The approach made use of the experience of purchasers in both their ability to assess supplier responses and recall previous dealings with a supplier. The reassessments which occurred during the inventory case analysis showed a weakness in this approach, as it became clearer where

experienced buyers had a previous relationship or some past knowledge of a supplier. Suppliers with a longer track record of delivery were more favoured by the assessment system which may be a further weakness. The questionnaire included a detailed examination of supplier capability. The judgement of purchasing practitioners and management remained an important part of the process. This method was the first in a series of stages needed to reach an agreement for MRO inventory services. The case developed an effective and efficient tool for practitioners. The tool avoids having to establish a series of lengthy and expensive trials for all of the suppliers, or ask nothing from the suppliers before entering into the tendering stages. Instead, this component helps to identify where on the scale this initial supplier assessment should sit. Time, cost, and accuracy are the considerations practitioners in the field are dealing with (particularly in these testing economic conditions). The approach described in this thesis was designed to balance these variables and therefore there were inevitable compromises to be reached. The results of these questionnaires represented the initial step in a series of negotiations between the parties which ultimately led to the establishment of vendor managed inventory for machine spares within the sponsor company.

10.6 Limitations

The author has made every effort to make the research contribution as generalisable as possible without diluting the core methodological proposal. However, as with every piece of research it is never possible to cover all limitations as decisions have to be made based on best judgement and advice, and these decisions inevitably require compromises to be reached. The following section identifies some of these compromises.

- The literature review identified through the use of a categorisation technique the core themes of the purchasing and supply management field. Other related fields were considered but not included in order to deliver a deep proposal.
- The research made use of a number of questionnaires. The CSR case study used an online supplier questionnaire, the inventory study uses a brief questionnaire, and the evaluation and validation stage of the research programme was also based on a questionnaire. This approach is often very useful and is a well established method in the purchasing and general research field. However, that is not to say that it is beyond any limitations. There remains a degree of subjectivity in the application of this technique. Despite all reasonable efforts, it is likely that the author missed data and insights which may or may not have confirmed the findings described in this thesis. There is also the issue of perception on the part of the participants. It is a common issue in such research for

participants to feel obliged to answer in a particular way, which they feel is expected of them, rather than speak in their true voice.

- The research was conducted in collaboration with a major manufacturing organisation. It is therefore possible that the opportunities to identify issues and concerns of smaller manufacturers have been missed. The findings described in this thesis cannot therefore be deemed confirmed beyond the constraints of the investigation. The validation process sought to alleviate this concern but cannot completely substitute for an extended study of this issue.
- While implementing the CSR component in the live environment, it has been found that certain aspects of the process are too rigid to deal with outlying scenarios. Specifically, where suppliers are not expected to be competent in all areas, they will still receive a lower grading, because the tool cannot selectively disregard elements of the assessment. This is not a limitation of the findings of the work, but rather the implementation and design of associated tool. In any case this is a concern for the implementation of the process beyond those scenarios similar to the one in which the research was conducted.
- The research was conducted in the UK automotive manufacturing sector. This sector has seen in decline for a number of years and faces much different challenges to the growing manufacturers of the BRIC nations. In this respect, the methodology emphasises the reduction of costs. The author regards this as a limitation because if the PCRRM were to be transplanted into a rapidly growing company, it may not be workable.

10.7 Future Research

This section sets out interesting areas for future research which could be undertaken to further generalise or otherwise strengthen the PCRRM in both research and practice.

- The use of case studies as a basis for the investigation of each component of the PCRRM was central to this research programme. However, it is important to recognise that the studies were all conducted in the same organisation. It would be interesting to take each of the components and apply them in a number of different scenarios. These may include:
 - Other automotive organisations
 - Organisations of different sizes
 - Different core products
 - Producers of services
 - Organisations operating in different countries

- Future research could be carried out to extend the PCRRM into other areas of operation within the wider purchasing and supply management domain. In particular, it would be interesting for work to be carried out in the field of logistics in order to investigate how this interacts with each component of the methodology, and especially with the inventory component.
- The deliverable of this research is the PCRRM and associated tools. The selection of this deliverable was due to constraints of the resources within the working environment of the sponsor company and the skills of the end users. It would be interesting for the PCRRM to be developed in a sophisticated development language such as Java. This work could further automate much of the processing and increase the efficiency of the methodology. The author also feels that this process of programming and tool development would undoubtedly highlight bottlenecks and require some re-design of people management and workflows.
- The results from most of the PCRRM as delivered to the purchasing manager are largely numbers based, and in particular they are costings. The CSR component is the exception to this. It would be interesting from a research perspective to identify other ways of delivering information to the purchasing manager in order for him/her to make informed decisions. A wider set of criteria may be useful, particularly if the PCRRM were to be transferred into other domains.
- The PCRRM has been developed to deliver risk and cost reductions. Future research may look to investigate how these findings could be relayed into strategic management decisions at the senior levels of an organisation. What ways this would be implemented and how this delivery would be created and consumed would be an interesting point to consider.

10.8 Conclusions

This final section of the thesis gives a comparison of the research objectives (as described in Chapter 4) and the research outcomes/achievements. Each of the objectives is discussed from both a research and a management perspective.

- Explore how strategic purchasing is implemented in the field and identify the key issues facing practitioners.
 - The research carried out a literature review which identified the scarcity of holistic and practicable methodologies to reduce costs and risks.

- The year on year trends were found to be largely unfavourable, constituting a challenging economic environment in which purchasing practitioners are operating.
- Provide a representation technique for the identification of price reduction candidates and the comparison of dissimilar supplier bids.
 - The research established a fair and effective means of comparing supplier bids that were dissimilar in size or focus.
- Capture the social responsibility competency of the supply base and provide a formal means of measuring and reporting supplier compliance.
 - The research established a corporate social responsibility (CSR) supplier risk assessment in an objective and repeatable way.
- Provide a representation technique for the identification of stock reduction candidates and investigate the use of supplier knowledge in stock reduction.
 - The research established a process for managing the identification of commodity groups to investigate, and the transfer of parts data and analytical findings between the parties.
- Design a skeleton methodology for strategic purchasing that assimilates the results of Objectives 2 to 4.
 - The research identified three components of purchasing practice and theory which form a holistic methodology.
- Validate the research results within the purchasing environment of the industrial collaborator (Objectives 2-4) and through structured interviews (Objective 5).
 - The research validated the findings in a live purchasing environment and by using academic and practitioner experts.

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Appendix A – Data Analysis

Manufacturer – Supplier – Commodity

Table 0-1. For the most significant manufacturers, the top three suppliers and commodities

Mnfr Name	Mnfr Value	Supplier	Sale Value	Cmdty Name	Cmdty Value
m1	£ 232,827.35	5183	£ 222,364.78	717	£ 149,276.92
		5185	£ 9,395.07	731	£ 17,877.30
		9002	£ 1,067.50	798	£ 15,554.38
m2	£ 138,561.32	8110	£ 198,824.20	712	£ 47,178.43
		9002	£ 6,541.46	711	£ 33,052.01
		5000	£ 2,664.46	726	£ 13,755.81
m3	£ 103,757.25	7262	£ 94,484.55	778	£ 70,793.31
		5000	£ 5,246.56	779	£ 6,286.96
		8143	£ 2,000.35	731	£ 4,876.50
m4	£ 93,640.61	7282	£ 71,092.14	734	£ 60,134.30
		8435	£ 12,295.94	735	£ 6,544.93
		5000	£ 3,500.59	793	£ 5,712.00
m5	£ 86,139.91	5000	£ 39,913.05	734	£ 21,414.10
		8413	£ 24,202.00	731	£ 15,543.12
		7282	£ 11,422.38	730	£ 13,787.01

Supplier – Manufacturer – Commodity

Table 0-2. For the most significant suppliers, the top three manufacturers and commodities

Splr Name	Sale Value	Mnfr Name	Mnfr Value	Cmdty Name	Cmdty Value
5000	£ 705,139.17	m5	£ 39,913.05	744	£ 50,924.43
		m8	£ 20,339.33	738	£ 45,807.05
		m9	£ 20,144.90	734	£ 39,609.96
5183	£ 314,761.77	m1	£ 222,364.78	717	£ 149,276.92
		m10	£ 62,052.28	792	£ 35,607.48
		m7	£ 22,819.39	798	£ 32,652.54
9002	£ 298,349.92	m11	£ 44,209.01	717	£ 57,052.21
		m12	£ 32,694.43	730	£ 33,391.75
		m7	£ 30,344.58	732	£ 26,449.27
7282	£ 220,711.91	m4	£ 71,092.14	734	£ 85,226.82
		m13	£ 24,234.42	762	£ 12,385.87
		m14	£ 13,553.96	712	£ 12,006.41
6120	£ 218,887.00	m15	£ 21,321.61	734	£ 15,431.62
		m16	£ 20,762.10	718	£ 14,737.55
		m17	£ 13,494.04	764	£ 14,642.85

Commodity – Supplier – Manufacturer

Table 0-3. For the most significant commodities, the top three suppliers and manufacturers

Cmdty Name	Cmdty Value	Splr Name	Sale Value	Mnfr Name	Mnfr Value
744	£ 309,745.55	5100	£ 65,685.63	m18	£ 70,745.55
		5000	£ 50,924.43	m19	£ 22,905.92
		6403	£ 17,872.79	m6	£ 22,114.57
734	£ 308,409.77	7282	£ 85,226.82	m4	£ 60,134.30
		5000	£ 39,609.96	m20	£ 33,253.62
		6919	£ 33,932.86	m21	£ 23,825.16
717	£ 220,715.01	5183	£ 149,276.92	m1	£ 149,276.92
		9002	£ 57,052.21	m22	£ 40,717.41
		7282	£ 11,369.47	m7	£ 10,989.45
738	£ 213,763.44	5000	£ 45,807.05	m23	£ 43,808.09
		6825	£ 43,969.41	m24	£ 18,099.97
		5010	£ 19,315.77	m6	£ 16,837.35
730	£ 177,626.45	5000	£ 37,987.81	m25	£ 28,839.98
		9002	£ 33,391.75	m26	£ 17,726.75
		6108	£ 20,269.12	m5	£ 13,787.01

KEY

- Common Manufacturer
- Common Supplier
- Common Commodity

Figure 0-1. Key to: common manufacturers, suppliers and commodities across perspectives

Appendix B – Correspondence

The first letter sent to the supplier companies was used as a means of informing them that the process was taking place and that they might be asked to participate in the questionnaire. This letter was sent several weeks prior to the dissemination of the questionnaire to allow the companies to prepare their information and systems for possible participation. In addition a summary of Toyota's new Supply Chain CSR was included to show the suppliers the areas that would be of interest in any future study. This communication was drafted in collaboration with the purchasing manager and included her signature at the bottom to confirm in the mind of the recipient that Toyota was serious about this process (Figure 0-1).



Figure 0-1. Initial letter to suppliers

The second letter sent to the supplier companies was to inform them that their organisation had been selected for inclusion in the questionnaire and provided an easy to use link to the questionnaire online (Figure 0-2)

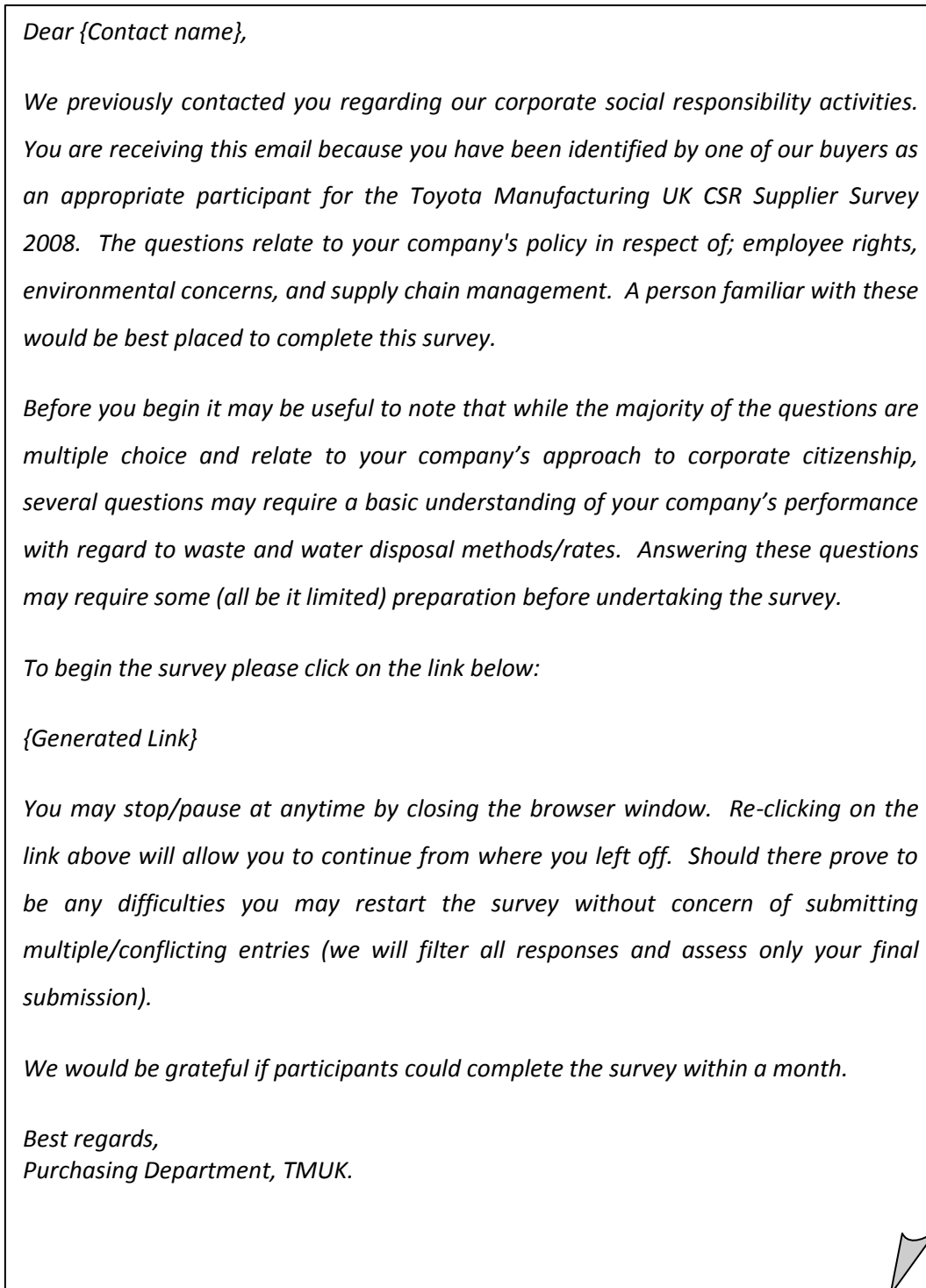


Figure 0-2. Confirmation of request to participate

The list of names and emails gathered in the risk assessment phase were used to directly contact the expected end participant. This was preferable to sending the email to a generic inbox that might well be read by someone lacking the knowledge to know where to send it to. The email was sent using the online questionnaire software and used special holding formulas to particular areas that were customisable per recipient. Firstly, each recipient received an email addressed to

them by name and secondly, the link in the email was set up to track the participants even if they did not provide proper information in the opening questions of the questionnaire. This communication also included a deadline for the questionnaire to be completed by. Again, the communication was sent using the Toyota email account and was signed with the Toyota Motor Manufacturing acronym TMUK.

The third email sent was needed to chase those participants who had yet to complete their questionnaire (Figure 0-3).

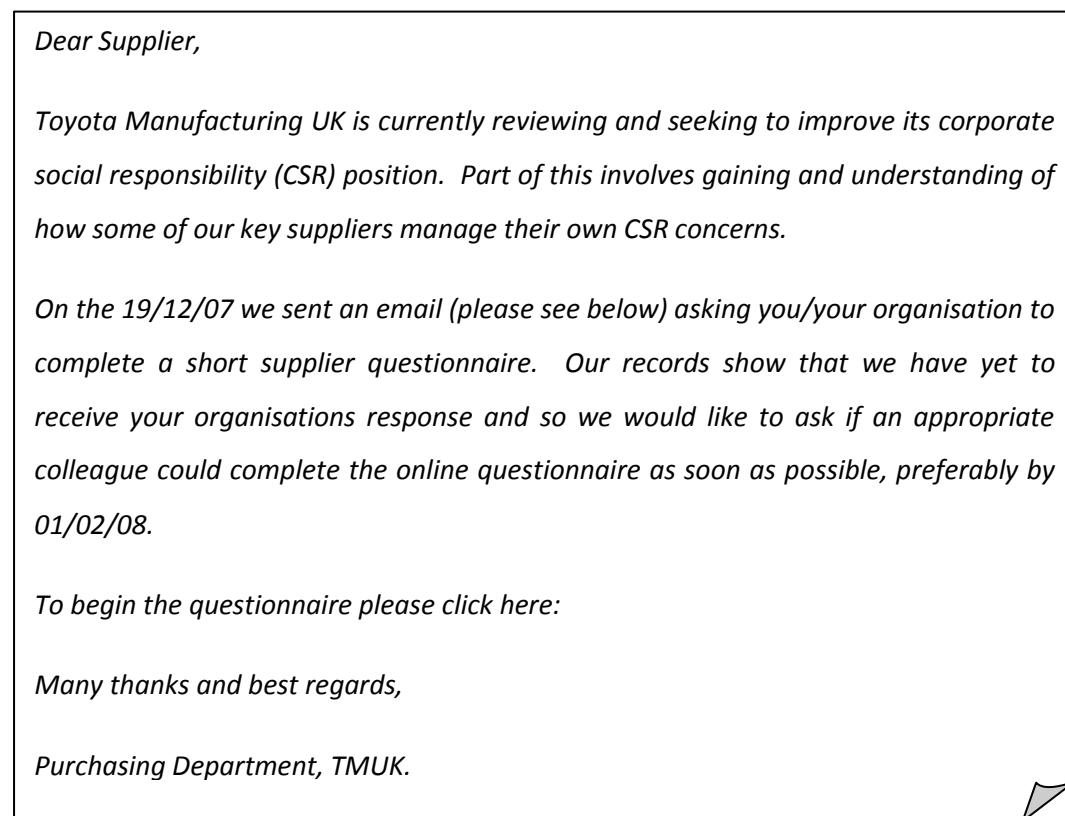


Figure 0-3. Chase email

Despite the chain of communications described already there remained a number of uncompleted questionnaires. It was discovered that some of the emails sent from the online questionnaire tool were being caught in spam filters which may have resulted in the participants not receiving the email with the link to the questionnaire. To deal with this an additional communication was sent out from the Toyota system with a generic link and a further extension to the deadline (Figure 0-4).

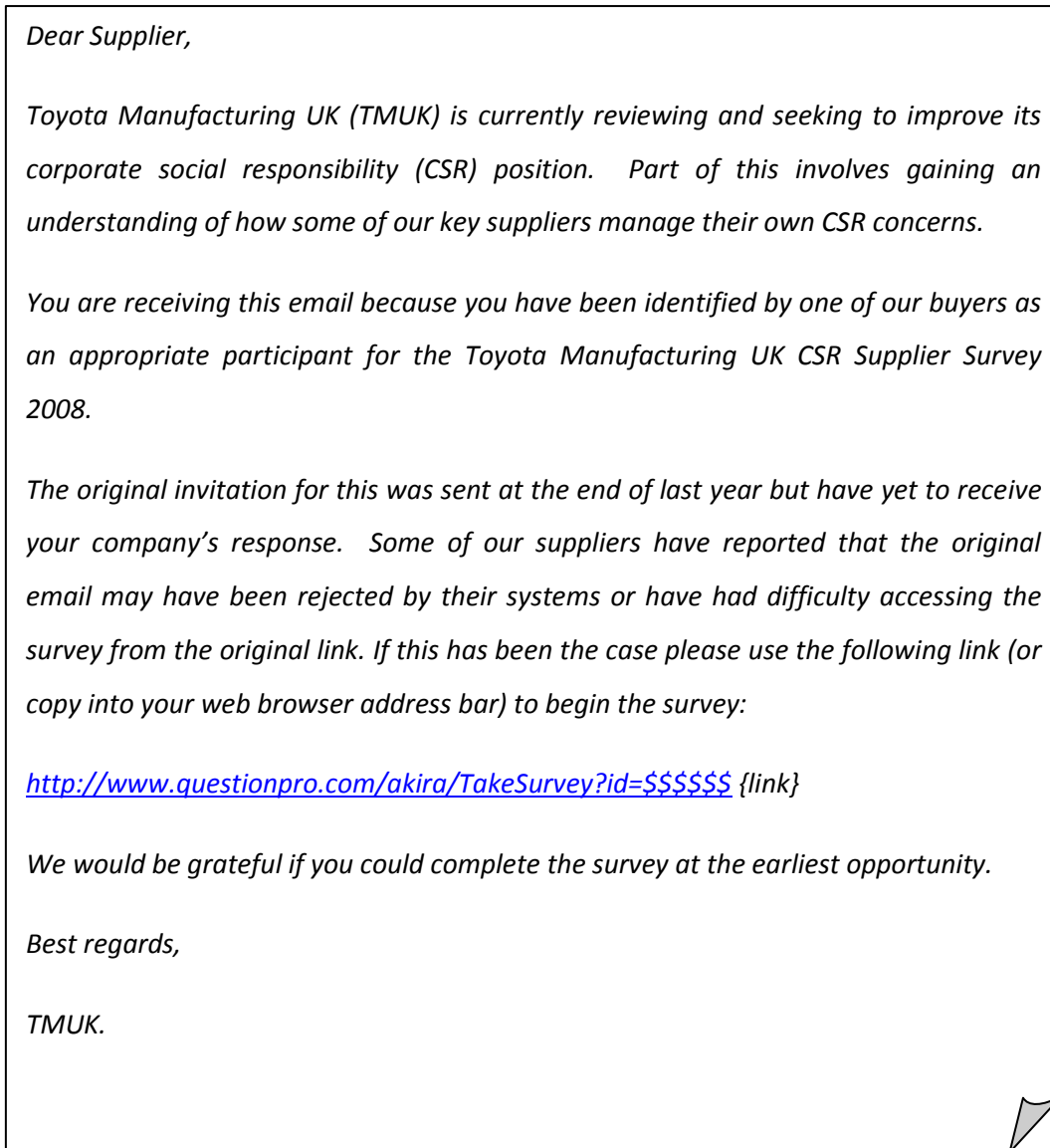


Figure 0-4. Correction for possible communication problems

Appendix C – Validation Questionnaires



Purchasing Cost and Risk Reduction Methodology EVALUATION QUESTIONNAIRE – [INDUSTRIAL]

The purpose of this questionnaire is to capture your opinion as a practitioner to the Purchasing Cost and Risk Reduction Methodology (PCRRM). This process of gathering feedback forms part of the validation process to be analysed and presented in the final thesis.

Please complete as many sections as you can and feel free to make additional comments if required.

Name

Adam Muldoon

Organisation

Toyota Motor Manufacture UK Ltd

Job title

Purchasing Specialist

EngD: A Methodology for Cost and Risk Reduction in Purchasing and Supply Management

Student: Kieron Younis

Supervisor: Dr Ash Tiwari

Feasibility

PLEASE TYPE AN 'X' IN YOUR CHOICE

1 (Completeness) The methodology comprises relevant components of a cost/risk reduction for purchasing and supply management.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

method works, always going to get something specific item that is difficult to plan for

2 (Consistency) The sequences of tasks within the methodology are consistent with one another.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

Broadly speaking yes, investigation, data analysis, proposal etc

3 (Applicability) The methodology could be successfully applied in other similar contexts.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

4 (Contingency) The methodology provides the user with alternative solutions dependent upon the data and context of the application.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

think options are limited, ultimate decision is, develop current supplier or re source

Usability

PLEASE TYPE AN 'X' IN YOUR CHOICE

5 (Time) The time required to implement/apply the methodology is within desirable limits.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

once set up, operationally the time should be a fraction

6 (Ease of Use) The tools and techniques within each component are realistically usable.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

with practice, I found CSR hard work at first to understand, familiarity with practical use

7 (Understanding) The aims and actions of the methodology are clear.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

8 (Flexibility) The methodology is sufficiently flexible in application.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

it seems bespoke for each specific element

Usefulness

PLEASE TYPE AN 'X' IN YOUR CHOICE

9 (Efficiency) The methodology requires reasonable resources to implement/apply.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments: especially in early stages				

10 (Satisfaction) The results fall within acceptable limits/expectations.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

11 (Success) The methodology was successful in meeting the aim/objectives.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☒	☐	☐	☐
Comments: the Erits project did not take account of the admin cost to re source a slow moving part				

12 (Practicality) The methodology is practical/realistic.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

13 (Benefit) The methodology brings benefit to purchasing and supply practitioners.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

Modification

PLEASE TYPE AN 'X' IN YOUR CHOICE

14 Which component of the methodology is most useful and why?

CSR

X

Acquisition

Inventory

Comments:

set the standard to review how suppliers are measured

15 Which component of the methodology is least useful and why?

CSR

Acquisition

Inventory

X

Comments:

would be good to build in a usage indicator where slow moving stock up to a certain total value is overlooked due to the admin cost to actually do something with that YK

16 Further comments

Design Features

PLEASE TYPE AN 'X' IN YOUR CHOICE

17 (Strategic Link) The methodology provides a link between corporate strategy and purchasing decisions.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

should be used in the decision making process

18 (Core Activities) The methodology successfully handles core activities.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

19 (Holistic Approach) The methodology provides a holistic approach to purchasing and supply issues.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

20 (Non-Financial Factors) The methodology successfully handles financial and non-financial factors.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

21 (Initial Investment) The methodology can be applied without substantial initial investment.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

I think that the first time would take time to gain the knowledge and be comfortable with the data

22 (Continuous Improvement) The methodology can be used as part of a continuous improvement programme.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

already has, CSR, for example

23 (Structure) The procedures are well defined, in a step-by-step approach.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
			X	
Comments:				

24 (Documentation) The methodology provides a well documented record of processes and results.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
			X	
Comments:				

25 (Tools and Techniques) The procedures of the methodology are appropriate.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
			X	
Comments:				

26 (Participation) The participants required by the methodology are appropriate.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
			X	
Comments:				

27 (Project Management) The methodology provides/retains useful data for in project planning.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
			X	
Comments:				

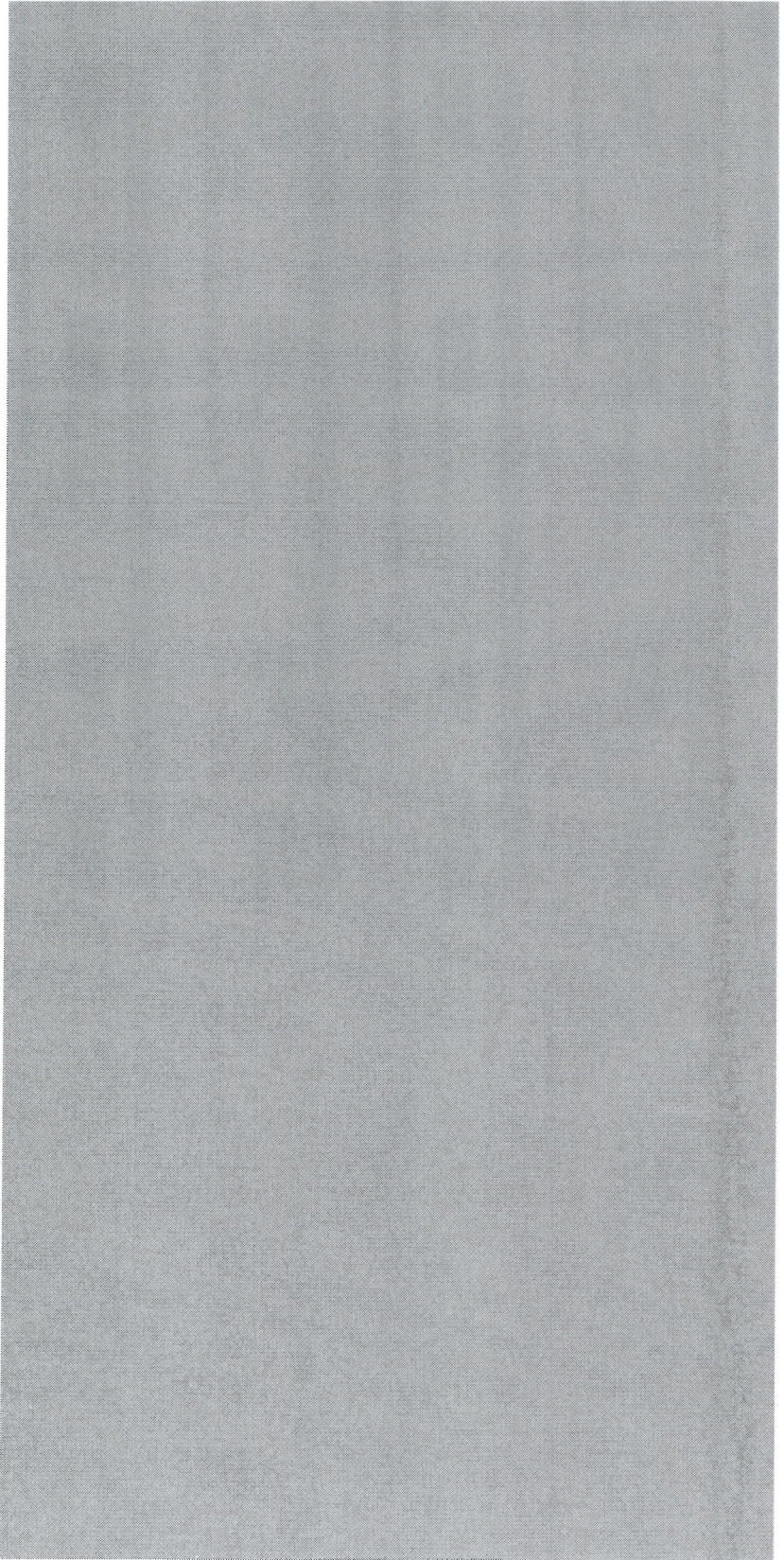
28 (Deliverables) The product/outcome is useful for practitioners.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
			X	
Comments:				

29 (Scope and Objectives) The methodology describes well-defined objectives.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
			X	
Comments:				

Any other comments





Purchasing Cost and Risk Reduction Methodology EVALUATION QUESTIONNAIRE – [INDUSTRIAL]

The purpose of this questionnaire is to capture your opinion as a practitioner to the Purchasing Cost and Risk Reduction Methodology (PCRRM).

This process of gathering feedback forms part of the validation process to be analysed and presented in the final thesis.

Please complete as many sections as you can and feel free to make additional comments if required.

Name

Vicky Cresswell

Organisation

Toyota UK

Job title

Specialist - Senior

EngD: A Methodology for Cost and Risk Reduction in Purchasing and Supply Management

Student: Kieron Younis

Supervisor: Dr Ash Tiwari

Feasibility

PLEASE TYPE AN 'X' IN YOUR CHOICE

1 (Completeness) The methodology comprises relevant components of a cost/risk reduction for purchasing and supply management.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

2 (Consistency) The sequences of tasks within the methodology are consistent with one another.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

3 (Applicability) The methodology could be successfully applied in other similar contexts.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

4 (Contingency) The methodology provides the user with alternative solutions dependent upon the data and context of the application.

Strongly Disagree

Disagree

Neither Agree Nor Disagree

Agree

Strongly Agree

Comments:

Usability

PLEASE TYPE AN 'X' IN YOUR CHOICE

5 (Time) The time required to implement/apply the methodology is within desirable limits.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
			X	
Comments:				

6 (Ease of Use) The tools and techniques within each component are realistically usable.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
			X	
Comments: Agree as a general principle. The matrix used for recording supplier CSR responses is not easy to understand the first time it is seen and requires some explanation.				

7 (Understanding) The aims and actions of the methodology are clear.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
			X	
Comments:				

8 (Flexibility) The methodology is sufficiently flexible in application.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
		X		
Comments: This has only been viewed from Toyota's required application				

Usefulness

PLEASE TYPE AN 'X' IN YOUR CHOICE

9 (Efficiency) The methodology requires reasonable resources to implement/apply.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

10 (Satisfaction) The results fall within acceptable limits/expectations.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

11 (Success) The methodology was successful in meeting the aim/objectives.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒
Comments:				

12 (Practicality) The methodology is practical/realistic.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

13 (Benefit) The methodology brings benefit to purchasing and supply practitioners.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

Modification

PLEASE TYPE AN 'X' IN YOUR CHOICE

14 Which component of the methodology is most useful and why?

CSR	Acquisition	Inventory
☒	☐	☐

Comments: This was a area new to the user and the company had no experience on how to approach the component

15 Which component of the methodology is least useful and why?

CSR	Acquisition	Inventory
☐	☒	☐

Comments: This was the component the company had more experience with and some of the methodology was already used but perhaps not documented in the same way

16 Further comments

The CSR tools are still used although modified. The scoring system gave poor results where some of the elements were not applicable to some suppliers, for example Derby Chamber of Commerce. The company has now implemented a full CSR or partial CSR requirement based on the service provided

Design Features

PLEASE TYPE AN 'X' IN YOUR CHOICE

17 (Strategic Link) The methodology provides a link between corporate strategy and purchasing decisions.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

18 (Core Activities) The methodology successfully handles core activities.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

19 (Holistic Approach) The methodology provides a holistic approach to purchasing and supply issues.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

20 (Non-Financial Factors) The methodology successfully handles financial and non-financial factors.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

21 (Initial Investment) The methodology can be applied without substantial initial investment.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

22 (Continuous Improvement) The methodology can be used as part of a continuous improvement programme.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐
Comments:				

23 (Structure) The procedures are well defined, in a step-by-step approach.

Strongly Disagree ☐ Disagree ☐ Neither Agree Nor Disagree ☒ Agree ☐ Strongly Agree ☐

Comments: _____

24 (Documentation) The methodology provides a well documented record of processes and results.

Strongly Disagree ☐ Disagree ☐ Neither Agree Nor Disagree ☐ Agree ☒ Strongly Agree ☐

Comments: _____

25 (Tools and Techniques) The procedures of the methodology are appropriate.

Strongly Disagree ☐ Disagree ☐ Neither Agree Nor Disagree ☐ Agree ☒ Strongly Agree ☐

Comments: _____
Some tools and techniques were not known to some individuals and the opportunity was taken to increase their knowledge in the use of the tools and techniques

26 (Participation) The participants required by the methodology are appropriate.

Strongly Disagree ☐ Disagree ☐ Neither Agree Nor Disagree ☐ Agree ☒ Strongly Agree ☐

Comments: _____

27 (Project Management) The methodology provides/retains useful data for in project planning.

Strongly Disagree ☐ Disagree ☐ Neither Agree Nor Disagree ☐ Agree ☒ Strongly Agree ☐

Comments: _____

28 (Deliverables) The product/outcome is useful for practitioners.

Strongly Disagree ☐ Disagree ☐ Neither Agree Nor Disagree ☐ Agree ☐ Strongly Agree ☒

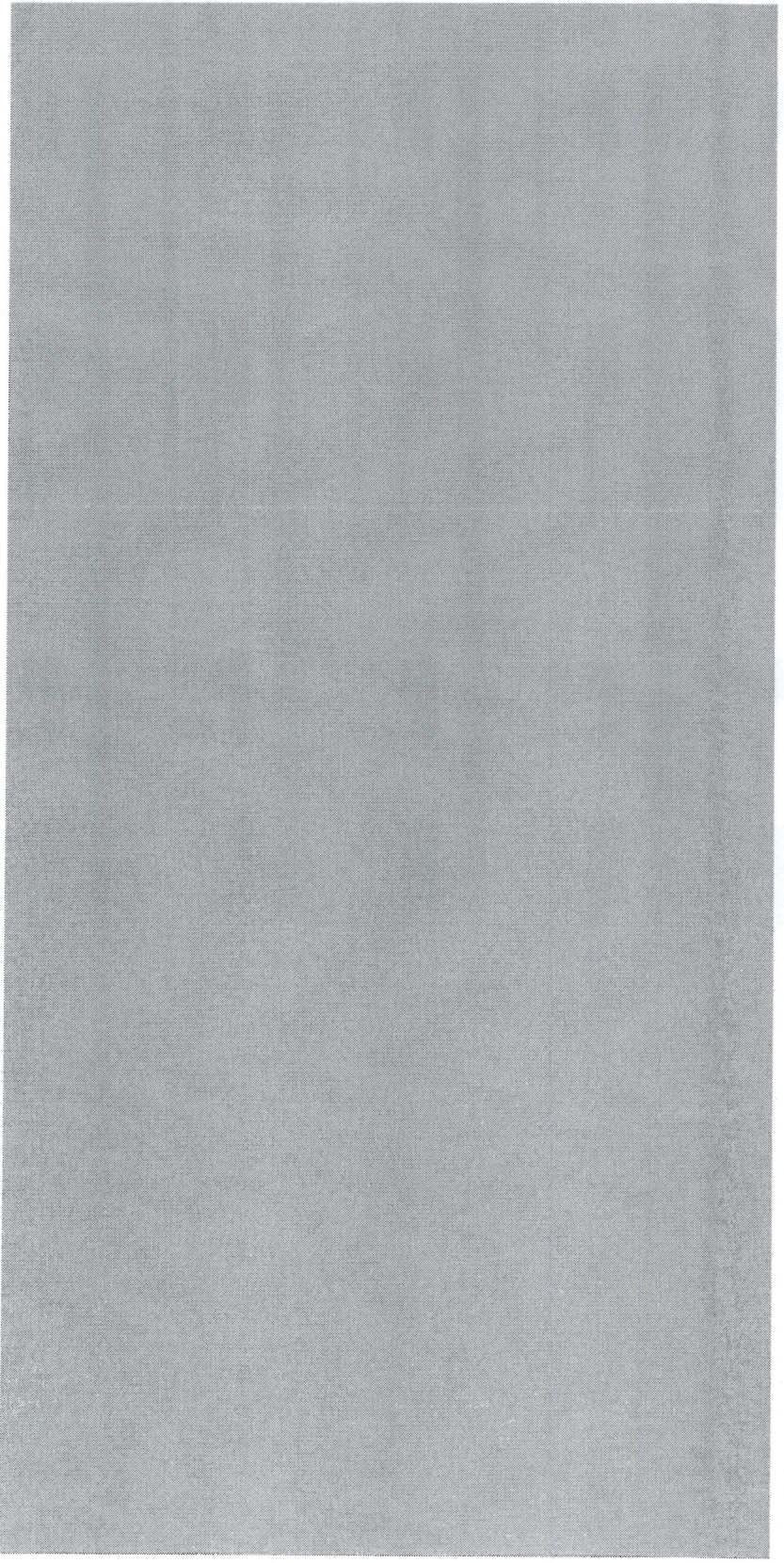
Comments: _____

29 (Scope and Objectives) The methodology describes well-defined objectives.

Strongly Disagree ☐ Disagree ☐ Neither Agree Nor Disagree ☐ Agree ☐ Strongly Agree ☒

Comments: _____

Any other comments



Purchasing Cost and Risk Reduction Methodology EVALUATION QUESTIONNAIRE – [ACADEMIC]

The purpose of this questionnaire is to capture your opinion as an academic/researcher to the Purchasing Cost and Risk Reduction Methodology (PCRRM). This process of gathering feedback forms part of the validation process to be analysed and presented in the final thesis.

Please complete as many sections as you can and feel free to make additional comments if required.

Name: CHRIS TURNER
Organisation: CRANFIELD UNIVERSITY
Job title: RESEARCH FELLOW

EngD: A Methodology for Cost and Risk Reduction in Purchasing and Supply Management

Student: Kieron Younis

Supervisor: Dr Ash Tiwari

Section A. Feasibility

1. **(Completeness)** The methodology comprises relevant components of a cost/risk reduction for purchasing and supply management.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

2. **(Consistency)** The sequences of tasks within the methodology are consistent with one another.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

3. **(Applicability)** The methodology could be successfully applied in other similar contexts.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

4. **(Contingency)** The methodology provides the user with alternative solutions dependent upon the data and context of the application.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

Section B. Usability

5. (Time) The time required to implement/apply the methodology is within desirable limits.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments: WILL IMPROVE FURTHER OVER TIME WITH COMPANY FAMILIARISATION

6. (Ease of Use) The tools and techniques within each component are realistically usable.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

7. (Understanding) The aims and actions of the methodology are clear.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

8. (Flexibility) The methodology is sufficiently flexible in application.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

Section C. Usefulness

9. (Efficiency) The methodology requires reasonable resources to implement/apply.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

10. (Satisfaction) The results fall within acceptable limits/expectations.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

11. (Success) The methodology was successful in meeting the aim/objectives.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments: COULD ALSO BUILD IN FEEDBACK TO COMPANY POLICY/
GUIDELINES *

12. (Practicality) The methodology is practical/realistic.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

13. (Benefit) The methodology brings benefit to purchasing and supply practitioners.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐☐☐☐☒

Comments:

Section D. Modification

14. Which component of the methodology is most useful and why?

CSR

Acquisition

Inventory

☐☒☐

Comments: REDUCES PRICE FIXING DEALS - HELPS TO ESTABLISH TRUE MARKET RATE

15. Which component of the methodology is least useful and why?

CSR

Acquisition

Inventory

☐☐☒

(STILL USEFUL THOUGH MORE
DIFFICULT TO IMPLEMENT)

Comments: COULD BE MORE DIFFICULT TO IMPLEMENT THAN OTHER TWO DUE
TO COMPANY STOCK CONTROLLERS V MAINTENANCE STAFF CONFLICT RISK

16. Further comments

* THERE NEEDS TO BE A FEEDBACK FROM THIS WORK INTO
COMPANY POLICY - E.G. PRODUCTION OF GUIDELINES ON
HOW TO DO BUSINESS WITH COMPANY (GIVEN TO SUPPLIERS) DRAWN
FROM CSR - AND FROM POLICY/STRATEGY INTO THE METHODOLOGY
SO IT CAN ADAPT OVER TIME - COULD BE SUGGESTED AS FURTHER
WORK (FUTURE RESEARCH) IN THESIS

Section E. Design Features

17. (Strategic Link) The methodology provides a link between corporate strategy and purchasing decisions.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐
☐
☐
☒
☐

Comments:

18. (Core Activities) The methodology successfully handles core activities.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐
☐
☐
☐
☒

Comments:

19. (Holistic Approach) The methodology provides a holistic approach to purchasing and supply issues.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐
☐
☐
☐
☒

Comments:

20. (Non-Financial Factors) The methodology successfully handles financial and non-financial factors.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐
☐
☐
☒
☐

Comments:

21. (Initial Investment) The methodology can be applied without substantial initial investment.

Strongly Disagree Disagree Neither Agree
Nor Disagree Agree Strongly Agree

☐☐☐☐☒

Comments:

22. (Continuous Improvement) The methodology can be used as part of a continuous improvement programme.

Strongly Disagree Disagree Neither Agree
Nor Disagree Agree Strongly Agree

☐☐☐☐☒

Comments:

23. (Structure) The procedures are well defined, in a step-by-step approach.

Strongly Disagree Disagree Neither Agree
Nor Disagree Agree Strongly Agree

☐☐☐☐☒

Comments:

24. (Documentation) The methodology provides a well documented record of processes and results.

Strongly Disagree Disagree Neither Agree
Nor Disagree Agree Strongly Agree

☐☐☐☐☒

Comments:

25. (Tools and Techniques) The procedures of the methodology are appropriate.

Strongly Disagree Disagree Neither Agree
Nor Disagree Agree Strongly Agree

☐☐☐☐☒

Comments:

26. (Participation) The participants required by the methodology are appropriate.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

27. (Project Management) The methodology provides/retains useful data for in project planning.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

28. (Deliverables) The product/outcome is useful for practitioners.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

29. (Scope and Objectives) The methodology describes well-defined objectives.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

[illegible]

Purchasing Cost and Risk Reduction Methodology EVALUATION QUESTIONNAIRE – [ACADEMIC]

The purpose of this questionnaire is to capture your opinion as an academic/researcher to the Purchasing Cost and Risk Reduction Methodology (PCRRM). This process of gathering feedback forms part of the validation process to be analysed and presented in the final thesis.

Please complete as many sections as you can and feel free to make additional comments if required.

Name: JEewan Jasoo

Organisation: CRANFIELD UNIVERSITY

Job title: PLD RESEARCHER

EngD: A Methodology for Cost and Risk Reduction in Purchasing and Supply Management

Student: Kieron Younis

Supervisor: Dr Ash Tiwari

Section A. Feasibility

1. (Completeness) The methodology comprises relevant components of a cost/risk reduction for purchasing and supply management.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

2. (Consistency) The sequences of tasks within the methodology are consistent with one another.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

3. (Applicability) The methodology could be successfully applied in other similar contexts.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments: *Maybe, it could be applied to other industrial domains not only - automotive.*

4. (Contingency) The methodology provides the user with alternative solutions dependent upon the data and context of the application.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

Section B. Usability

5. (Time) The time required to implement/apply the methodology is within desirable limits.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☒	☐	☐

Comments:

6. (Ease of Use) The tools and techniques within each component are realistically usable.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

7. (Understanding) The aims and actions of the methodology are clear.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

8. (Flexibility) The methodology is sufficiently flexible in application.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☒	☒	☐

Comments: these not

Section C. Usefulness

9. (Efficiency) The methodology requires reasonable resources to implement/apply.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments: *Use of Excel as a tool proved useful.*

10. (Satisfaction) The results fall within acceptable limits/expectations.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

11. (Success) The methodology was successful in meeting the aim/objectives.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

12. (Practicality) The methodology is practical/realistic.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

13. (Benefit) The methodology brings benefit to purchasing and supply practitioners.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐☐☐☐☒

Comments:

Section D. Modification

14. Which component of the methodology is most useful and why?

CSR

Acquisition

Inventory

☒☐☐

Comments: *Supplier Evaluation process is useful for scoring suppliers based on general criteria.*

15. Which component of the methodology is least useful and why?

CSR

Acquisition

Inventory

☐☐☒

?

Comments: *(Come see me - not sure)*

16. Further comments

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Section E. Design Features

17. (Strategic Link) The methodology provides a link between corporate strategy and purchasing decisions.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

18. (Core Activities) The methodology successfully handles core activities.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

19. (Holistic Approach) The methodology provides a holistic approach to purchasing and supply issues.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

20. (Non-Financial Factors) The methodology successfully handles financial and non-financial factors.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

21. (Initial Investment) The methodology can be applied without substantial initial investment.

Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

☐☐☐☐☒

Comments:

22. (Continuous Improvement) The methodology can be used as part of a continuous improvement programme.

Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

☐☐☐☐☒

Comments:

23. (Structure) The procedures are well defined, in a step-by-step approach.

Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

☐☐☐☐☒

Comments:

24. (Documentation) The methodology provides a well documented record of processes and results.

Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

☐☐☐☒☐

Comments:

25. (Tools and Techniques) The procedures of the methodology are appropriate.

Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

☐☐☐☒☐

Comments:

26. (Participation) The participants required by the methodology are appropriate.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐☐☐☒☐

Comments:

27. (Project Management) The methodology provides/retains useful data for in project planning.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐☐☐☒☐

Comments:

28. (Deliverables) The product/outcome is useful for practitioners.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐☐☐☒☐

Comments:

29. (Scope and Objectives) The methodology describes well-defined objectives.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐☐☐☒☐

Comments:

Section F. Any other comments

- it would be useful to apply this methodology
to other sectors and their supply chains
to see if it would also be valid.

Purchasing Cost and Risk Reduction Methodology EVALUATION QUESTIONNAIRE – [ACADEMIC]

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Please complete as many sections as you can and feel free to make additional comments if required.

Name: MICHAEL, FARNSWORTH
Organisation: CRANFIELD
Job title: STUDENT

EngD: A Methodology for Cost and Risk Reduction in Purchasing and Supply Management

Student: Kieron Younis

Supervisor: Dr Ash Tiwari

Section A. Feasibility

1. **(Completeness)** The methodology comprises relevant components of a cost/risk reduction for purchasing and supply management.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

2. **(Consistency)** The sequences of tasks within the methodology are consistent with one another.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☒	☐	☐

Comments:

3. **(Applicability)** The methodology could be successfully applied in other similar contexts.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

4. **(Contingency)** The methodology provides the user with alternative solutions dependent upon the data and context of the application.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

Section B. Usability

5. (Time) The time required to implement/apply the methodology is within desirable limits.

Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

☐ ☐ ☐ ☒ ☐

Comments: Risk involved with 3rd party Log time (waiting) however

6. (Ease of Use) The tools and techniques within each component are realistically usable.

Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

☐ ☐ ☐ ☒ ☐

Comments: Seems to be a well developed set of tools using established software (excel etc)

7. (Understanding) The aims and actions of the methodology are clear.

Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

☐ ☐ ☒ ☐ ☐

Comments: Each individual component is clear (CSR, Sourcing...)

8. (Flexibility) The methodology is sufficiently flexible in application.

Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

☐ ☐ ☒ ☐ ☐

Comments: Yes in that Tools themselves are flexibly designed and each Component (CSR, Sourcing) look to be sufficiently decomposed as to allow flexible alteration without such Rigidity that the whole thing collapses.

-possibly a no simply because after roll out, how realistic would it be to go back to companies and Suppliers and present a new methodology.

Section C. Usefulness

9. (Efficiency) The methodology requires reasonable resources to implement/apply.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐
☐
☐
☒
☐

Comments:

Doesn't seem to require too many resources (money, men)
only time being the main issue.

10. (Satisfaction) The results fall within acceptable limits/expectations.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐
☐
☐
☒
☐

Comments:

Reasonable cost savings and Risk assessment

11. (Success) The methodology was successful in meeting the aim/objectives.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐
☐
☐
☒
☐

Comments:

Meets/combats each component very well

12. (Practicality) The methodology is practical/realistic.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐
☐
☐
☒
☐

Comments:

Trivial success points to this!

13. (Benefit) The methodology brings benefit to purchasing and supply practitioners.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments: *Not to much stick and enough carrot*

Section D. Modification

14. Which component of the methodology is most useful and why?

CSR	Acquisition	Inventory
☐	☐	☒

Comments: *Good, clean, classic efficiency and logical approach to tackling problem faced.*

15. Which component of the methodology is least useful and why?

CSR	Acquisition	Inventory
☐	☒	☐

Comments: *Only possibly is that I find the basis of some of the unknown information on a extrapolated Average risky*

16. Further comments

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Section E. Design Features

17. (Strategic Link) The methodology provides a link between corporate strategy and purchasing decisions.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☒	☐	☐

Comments:

18. (Core Activities) The methodology successfully handles core activities.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

19. (Holistic Approach) The methodology provides a holistic approach to purchasing and supply issues.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

20. (Non-Financial Factors) The methodology successfully handles financial and non-financial factors.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☒	☐	☐

Comments:

21. (Initial Investment) The methodology can be applied without substantial initial investment.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☒	☐	☐	☐

Comments:

22. (Continuous Improvement) The methodology can be used as part of a continuous improvement programme.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

23. (Structure) The procedures are well defined, in a step-by-step approach.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

24. (Documentation) The methodology provides a well documented record of processes and results.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

25. (Tools and Techniques) The procedures of the methodology are appropriate.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

26. (Participation) The participants required by the methodology are appropriate.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

27. (Project Management) The methodology provides/retains useful data for in project planning.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

28. (Deliverables) The product/outcome is useful for practitioners.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

29. (Scope and Objectives) The methodology describes well-defined objectives.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

[illegible]

Purchasing Cost and Risk Reduction Methodology EVALUATION QUESTIONNAIRE – [ACADEMIC]

The purpose of this questionnaire is to capture your opinion as an academic/researcher to the Purchasing Cost and Risk Reduction Methodology (PCRRM). This process of gathering feedback forms part of the validation process to be analysed and presented in the final thesis.

Please complete as many sections as you can and feel free to make additional comments if required.

Name:

Windo Hutabarat

Organisation:

Cranfield University

Job title:

Research Fellow

EngD: A Methodology for Cost and Risk Reduction in Purchasing and Supply Management

Student: Kieron Younis

Supervisor: Dr Ash Tiwari

Section A. Feasibility

1. **(Completeness)** The methodology comprises relevant components of a cost/risk reduction for purchasing and supply management.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

2. **(Consistency)** The sequences of tasks within the methodology are consistent with one another.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

3. **(Applicability)** The methodology could be successfully applied in other similar contexts.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

4. **(Contingency)** The methodology provides the user with alternative solutions dependent upon the data and context of the application.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☒	☐	☐

Comments: *The question encompasses too wide an area.*

Section B. Usability

5. (Time) The time required to implement/apply the methodology is within desirable limits.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐☐☐☒☐

Comments:

6. (Ease of Use) The tools and techniques within each component are realistically usable.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐☐☐☐☒

Comments:

7. (Understanding) The aims and actions of the methodology are clear.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐☐☐☒☐

Comments:

8. (Flexibility) The methodology is sufficiently flexible in application.

Strongly Disagree

Disagree

Neither Agree
Nor Disagree

Agree

Strongly Agree

☐☐☐☒☐

Comments:

Section C. Usefulness

9. (Efficiency) The methodology requires reasonable resources to implement/apply.

Strongly Disagree

☐

Disagree

☐

Neither Agree
Nor Disagree

☐

Agree

☐

Strongly Agree

☒

Comments:

10. (Satisfaction) The results fall within acceptable limits/expectations.

Strongly Disagree

☐

Disagree

☐

Neither Agree
Nor Disagree

☐

Agree

☒

Strongly Agree

☐

Comments:

11. (Success) The methodology was successful in meeting the aim/objectives.

Strongly Disagree

☐

Disagree

☐

Neither Agree
Nor Disagree

☐

Agree

☒

Strongly Agree

☐

Comments:

12. (Practicality) The methodology is practical/realistic.

Strongly Disagree

☐

Disagree

☐

Neither Agree
Nor Disagree

☐

Agree

☐

Strongly Agree

☒

Comments:

13. (Benefit) The methodology brings benefit to purchasing and supply practitioners.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

Section D. Modification

14. Which component of the methodology is most useful and why?

CSR	Acquisition	Inventory
☐	☐	☒

Comments: *clear, short path to "saving money"* ↙ project aims

15. Which component of the methodology is least useful and why?

CSR	Acquisition	Inventory
☒	☐	☐

Comments: *distant link to "saving money"*

16. Further comments

.....

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.....

.....

Section E. Design Features

17. (Strategic Link) The methodology provides a link between corporate strategy and purchasing decisions.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments: *CSR to identify suppliers that support strategy*

18. (Core Activities) The methodology successfully handles core activities.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

19. (Holistic Approach) The methodology provides a holistic approach to purchasing and supply issues.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☒	☐	☐

Comments: *I lack expertise to judge*

20. (Non-Financial Factors) The methodology successfully handles financial and non-financial factors.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments: *CSR seem to be non-financial*

21. (Initial Investment) The methodology can be applied without substantial initial investment.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

22. (Continuous Improvement) The methodology can be used as part of a continuous improvement programme.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments:

23. (Structure) The procedures are well defined, in a step-by-step approach.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☐	☒

Comments: *Very well structured.*

24. (Documentation) The methodology provides a well documented record of processes and results.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments:

25. (Tools and Techniques) The procedures of the methodology are appropriate.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
☐	☐	☐	☒	☐

Comments: *though feedback from 3rd party may be a funding issue.*

26. (Participation) The participants required by the methodology are appropriate.

Strongly Disagree Disagree Neither Agree
Nor Disagree Agree Strongly Agree

☐☐☒☐☐

Comments:

27. (Project Management) The methodology provides/retains useful data for in project planning.

Strongly Disagree Disagree Neither Agree
Nor Disagree Agree Strongly Agree

☐☒☐☐☐

Comments: *Not sure I agree, seems more appropriate for a company level wide approach*

28. (Deliverables) The product/outcome is useful for practitioners.

Strongly Disagree Disagree Neither Agree
Nor Disagree Agree Strongly Agree

☐☐☐☒☐

Comments:

29. (Scope and Objectives) The methodology describes well-defined objectives.

Strongly Disagree Disagree Neither Agree
Nor Disagree Agree Strongly Agree

☐☐☐☒☐

Comments:

Section F. Any other comments

Very Well Structured Methodology, with what would seem a fully fleshed set of supporting tools

The trials seemed successful and the methodology itself already looks to be having an impact.

