The development of a generic outsourcing decision model with validation through automotive industry case studies.

THE DEVELOPMENT OF A GENERIC OUTSOURCING DECISION MODEL WITH VALIDATION THROUGH AUTOMOTIVE INDUSTRY CASE STUDIES

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Chapter 1: INTRODUCTION

"If we have one tradition it is this:

Everything can always be done better than it is being done"

Henry Ford 1926

Henry Ford's comment above (Ford, 1926) is perfectly rational and indicates that things do not stand still. With new knowledge, developing techniques, pure willpower and thirst for knowledge, there will always be the possibility that greater efficiencies can be obtained in any field within a given time. The research reflected in this Thesis is in recognition of this in that it recognises the possibility that a given process may provide significant benefit to an organisation, however, the perceived benefits that may be reaped within one organisation may not automatically be achieved by another.

1.1 Background

Today, many large companies are outsourcing functions that were normally conducted in-house in order to reduce capital overheads and gain advantages from utilising the expertise of external suppliers. In fact, outsourcing is a potentially growing phenomenon, according to the estimation of Lankford et al. (1999), every Fortune 500 company will consider outsourcing during the decade and 20% will enter into a contract by the end of the next decade. Some may even eventually achieve the status of a "virtual company", outsourcing almost everything (Carson, 2004).

Looking back in history to Henry Ford, the founder of Ford Motor Company and one of the pioneers of mass production, one can see that the philosophy was entirely different. By 1915, Ford was almost totally vertical integrated, making cars from the basic raw material, reaching a peak in 1931 at the Rouge complex in Detroit (Womack et al. 1990). Many reasons justified this, not least the fact that the Ford had perfected mass production before his suppliers and therefore could achieve substantial cost savings by doing everything himself (Ford, 1926). Initially, Ford endeavoured to manufacture as much of the vehicle as possible under one roof but Ford, constantly looking at ways of improving things made the following observations; "When we began to make our own parts we practically took for granted that they all had to be made in one factory - that there was some special virtue in having a single roof over the manufacture of the entire car. We have now developed away from this. If we build any more large factories, it will be only because the making of a single part must be in such tremendous volume as to require a single unit". Ford continued, "So now we are on our way back to where we started from - excepting that instead of buying our parts on the outside, we are beginning to make them in our own factories on the outside" (Ford, 1926), indicating a change from manufacturing a vehicle under one roof to having separate plants for major components.

According to Bloomberg (2002), within the European Car Industry 72% of the car value comes from suppliers, up from 65% in 1990 and projected to increase to 80% by 2010 according to the Centre for Automotive Research. Today the emphasis is on outsourcing parts/services that have been traditionally conducted in house to a level that in 2000 Ford purchasing represented $91 billion of a $160 billion turnover (Winter et al. 2000). Despite Henry Ford's philosophy and

practices, one can see that he evolved an approach that was obviously appropriate at that time reflected by his success record. Initially Ford bought in engines and 90 % of parts (Ford, 1926), developing into a totally vertically integrated organisation manufacturing almost 100% of the parts (Womack et al. 1990). The step to today's outsourcing trend within Ford and other organisations can be seen as a positive view in Henry Ford's perspective through his words about his positive attitude towards the future; "Nobody anywhere can really do more than guess about the future costs of production. It is wiser to recognise that the future holds more than the past - that every day holds within it an improvement on the methods of the day before" (Ford, H., 1926) and more specifically a further related comment that could be related to Core/Non-Core competency; "Whoever does a thing best ought to be the one doing it. It is criminal to try to get a business away from another man - criminal because one is then trying to lower for personal gain the condition of one's fellow-men, to rule by force instead of by intelligence".

In 2000 Ford Motor Company adopted the strategy identifying suppliers to design and develop commodities for fuel and other systems as "Full Service Suppliers" (Ford Motor Company Ltd, 2000b). At this time the Author was involved within the process, particularly within the aspect regarding supplier selection. In order to provide a deeper understanding of why this greater dependency upon the resources of the suppliers through outsourcing was being undertaken it was decided to utilise this subject as the basis for the following research. However, during the research period this strategy was ceased (Armstrong, 2003), therefore prompting Ford to drop the term "Full Service

Supplier" (Ford Motor Company Ltd, 2003). This came at a time when suppliers believed that Ford had lost technical competence (Automotive News 2002)
This change of direction whilst being of minor disruption to the research did in fact provide a new facet within the research.

1.2 Aims and Objectives of Research

The following aims and objectives are listed in chronological order rather than order of importance in order to reflect the logical process steps of knowledge accumulation throughout the research.
Prior to disclosing the aims and objectives of the research, a broad in-depth understanding of the subject of outsourcing would be necessary through literature review. This would not only include what to outsource, the reasons and methods of implementation but also potential negative aspects. This deeper understanding would then become the foundation for the following aims and objectives.

1. **To develop a "one stop" generic decision making matrix (Outsourcing Decision Model)** that provides the necessary clarity into defining whether an organisation should proceed with an outsourcing initiative or not. This would be based upon a distillation of existing models and reviewed literature. With the recognition that there may be subsequent advantages following the process, the model will include not only these but a means of evaluation in order to ascertain whether or not an outsourcing initiative may be or was successful or not. This latter aspect must logically be viewed as very

important as an outsourcer must be aware of the benefits and also whether or not they were achieved. In addition, the model would include sufficient guidance with potential supporting metrics and their application.

2. **To validate the Outsourcing Model through specific case studies using a triangulated approach in comparing the selected automotive OEM with some of its major competitors**. Within the context of the case study, the research would also attempt to understand how the subject outsourcing organisation compares to its major competitors in equivalent comparable products and whether or not this reflects in the success of these companies. This case study not only provides a means of reinforcing the remaining case studies by using a triangulated method of application to the research developed outsourcing decision model but also provides a deeper understanding of the context of the supplier and competitors within the industry.

3. **To test, via case studies the effect of specificity** relating to the outsourced end product rather than the outsourced entity. This aspect provides the deepest application to the researched outsourcing decision model and therefore the most comprehensive validation. In addition, because the case studies are retrospective, they have the benefit of providing data to establish the level of success. This would be very important, particularly as it would enable a focus on particular criteria that failed to highlight a particular outcome and therefore provide a chance to make amendments. Low specificity is a well established criterion in defining an outsourced entity

which is reflected within the body of the research. The further extension of this theory towards the outsourcing of and *outsourced entity* related to an established previously *outsourced commodity* is a new concept with no identifiable literature or evidence relating to its importance. The fact that it provides an element within the research that is potentially unique and carries no extra task burden it has been captured as an added element within the two important validation case studies:

4. **To evaluate if outsourcing performance can be enhanced through the introduction of a second supplier** into a single supplier sourcing situation. Subsequent to outsourcing, this aim and objective focuses upon the possibility of enhancing performance through the introduction of a second supplier. Particularly in cases whereby expertise may have been lost from an outsourcer, ultimate results relating to the outsourced entity may be compromised through either opportunism or diminished supplier performance. Whether these aspects are deliberate or unintended, an outsourcer should have some means of mitigating this risk. This mitigation may potentially be enabled through the use of a second supplier in order to provide a degree of competition.

5. **To identify a link between Specificity, Commonality and Platform Sharing.** The Author's professional role was very heavily based around the modern practices within the Automotive Industry. Outsourcing, platform sharing and commonality are well publicised strategies that have been adopted by various car manufacturers in order to gain efficiencies. Research

was carried out in order to provide a better understanding of these strategies and to establish if there is any link between them. A confirmation of any linkages may then provide potential for establishing greater synergies between them.

Chapter 2: LITERATURE REVIEW

2.1 Relationship between Outsourcing, Corporate Strategy and Environment

Any strategy by definition is only a plan (Collins, 1992) and therefore theoretically has the possibility to be changed to meet new demands. Outsourcing, similar to any other organisational activity should be based upon a planned action for best effect and therefore can also be considered as whole or part of a strategy.

Mintzberg et al. (1985) breaks down a strategy into four categories; either deliberate, emergent, intended or enforced. Whilst an enforced strategy or even one derived by accident (Harberberg et al. 2001) may arise, the following research is based upon a conscious decision regarding outsourcing which would be part of either a deliberate, emergent or intended strategy determined by the leadership of the organisation.

The work of Lynch (1997) identifies that any strategy is influenced by the environments it works within and broadly falls into a response to one or both of two major environmental influences at a broad global level (Ansoff et al. 1990) and at an industry level (Porter, 1980).

The principle of using the global and industry, level environments in order to investigate the topic of outsourcing of intellectual competence will become the basis for the following work.

From reading the work of Lynch (1997), Ansoff et al. (1990 and Porter (1980) it is clear that each environment provides unique forces that may influence a corporate outsourcing strategy. The global environment by its very nature is large and generic but whilst it may have influences on a corporate direction at a macro level it is highly unlikely to be reflected in a detailed analysis. Based upon this it will be investigated together with the industry environment within the arena of Corporate Strategy.

2.1.1 Corporate strategy - Global environment

Global influences are numerous and can be broken down into many elements including wars, trade barriers, data handling innovations, etc (Lynch, 1997b) and typically fall into a category that affects all industries at the macro level. Whilst in some cases they may affect industry competitors in different ways, there is very little that a given organisation can do to change the influence. However an organisation must consider a response in a given strategy. In Appendix 1, (Ansoff et al. 1990) both “Changeability” and “Predictability” are shown relative to a given environment. Appendix 1 clearly shows the potential complexity of forces that act upon an organisation with many forces externally driven and therefore beyond its own control.

The extremes of turbulence, level 1-5, reflect situations that would require totally different responses. A low environmental turbulence at one extreme would enable the formulation of a strategy based upon high level of confidence whereas the other extreme provides very little predictability of strategic outcomes necessitating a flexible and responsive strategy in order to adapt quickly to

change. Whilst the global environment may always provide new scenarios that should be considered within the decision making process, it is the industry environment that must actually determine a new strategy. Under this circumstance the strategy whilst being influenced by the global environment would clearly remain within the industry environment.

2.1.2 Corporate strategy - Industry environment

Referring to Appendix 2, Lynch (1997), environmental forces at a macro level can influence a strategic change within an organisation but there must also be further forces involved within any given industry. Appendix 2 illustrates the nature of some of these forces related to the stages of the life cycle of a maturing industry. Going from the Introduction through to the Decline one can observe characteristics that are prevalent at each phase with clear strategic pointers to actions necessary to optimise the competitiveness.

2.1.2.1 Industry life cycle

Referring to Figure 2.1, Lynch (1997), Figure 2.1 illustrates that changes in industry sales occur as time progresses through the product life cycle. By observing this with Appendix 2 it is apparent that the likelihood of outsourcing as a potential strategy may develop in intensity from the “Maturity” through to “Decline” phases as the profitability from the product is weakening. Whilst the life cycle of an organisation provides a possible indicator as to when a company may adopt an outsourcing strategy it should not be viewed as a

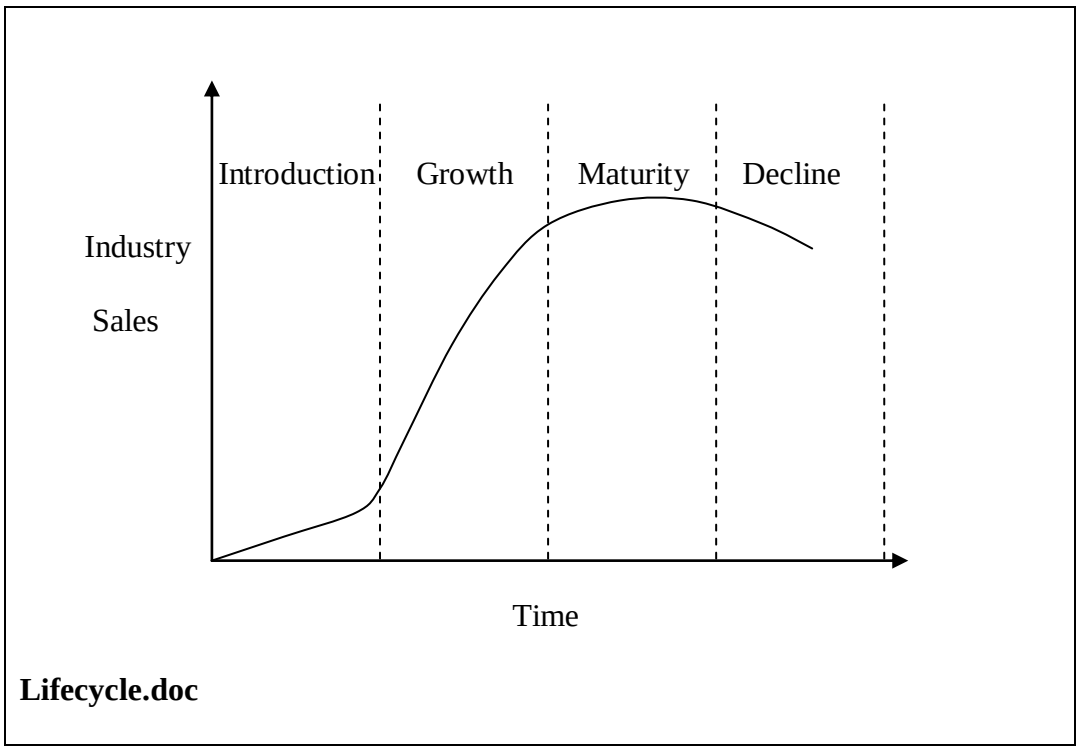

Figure 2.1: Stages of the Industry Life Cycle (Lynch, 1997)

particular criterion as it must really depend upon the product/service being outsourced and the relative risks/advantages associated to the business.

2.1.2.2 Porter's Five Forces

In Figure 2.2, Porter (1980) provides a clearer picture that may be helpful in determining a strategy by analysing five forces. Whilst the industry life cycle provides some indicators of a maturing industry Porter provides some greater clarity on the real influences that may depict a situation at any time within an industry life cycle. For example, in a declining stage of an industry, the buyers power increases thereby increasing competition within the industry. At this point a company may be looking at reducing costs through its suppliers. Similarly if there are many suppliers the company may be able to strengthen its position,

however if suppliers are few then this may be more difficult as the supplier would then have greater negotiating power.

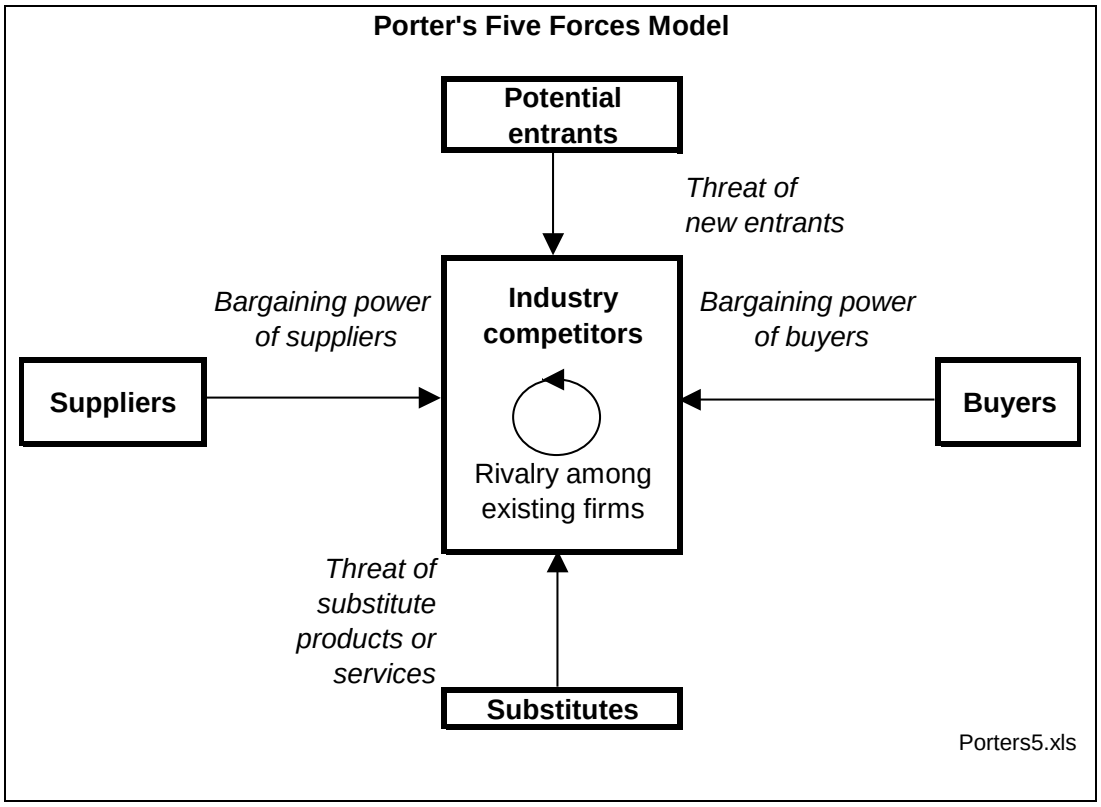

Figure 2.2: Porter's Five Forces Model (Porter 1980)

2.1.3 Global and industry environment: Characteristics of a potential outsourcer

The research within this chapter so far predominantly based upon the works of Mintzberg et al. (1985), Lynch (1997) and Porter (1980) clearly indicate some characteristics of an organisation that may be embarking upon an outsourcing strategy. In order to illustrate these characteristics and confirm parallels with each other these characteristics have been captured in (Table 2.1). Referring to the industry environment level, Porter's five forces are clearly very prominent in

reflecting these characteristics. However the effect of the global environment is less compelling.

Since level of turbulence whether high or low in the dynamics of the environment (Ansoff et al. 1990) show no particular guidance that would obviate an outsourcing strategy, it is easy to dismiss turbulence level as a factor in an outsourcing decision. The fact that outsourcing could be a potential strategy at both high and low levels of turbulence does provide some indication that it is not relevant in the case of outsourcing

Table 2.1: Global/Industry Level Environment Characteristics of a Potential Outsourcer

Characteristic of an organisation that is likely to consider an outsourcing strategy.	**(Mintzberg & Walters**	**LynchR (XXX)**	**Porter**
Part of a Strategy decided in advance by leadership of organisation.	X		
Industry in Mature/Decline Phase defined by:		X	
Customer Mass market		X	X
Customer brandswitching		X	X
Customer selects on basis of price rather than innovation		X	X
Reduced expenditure on Research and Development		X	
Company seeks cost reductions		X	
Expensive to increase market share		X	
Profits under pressure from continuing need for investment		X	
Price competition may lead to losses or need to cut costs drastically in order to maintain profitability		X	X
Company may be seeking to exit industry		X	
A potential threat of new entrants			X
Characteristics.xls			

Likewise, the Industry life cycle shows no particular phase as to when an outsourcing strategy could be implemented. However the evidence does show a bias towards the mature/decline phase.

The evidence provided so far shows that the industry environment provides the major driver for an outsourcing strategy.

2.2 Definition of Outsourcing

The work of Baines et al. (2000) as shown in Appendix 3, provides a comprehensive survey of literature with the conclusion that the overall viewpoint was somewhat confused. Lankford et al. (1999) provide a clear definition with Lonsdale (1999) providing a slight modification by referring to "transfer of previously in-house activities to a third party". Lonsdale's reference to "previously in house activities" is particularly important in that it infers that at some time in the past, the outsourcing organisation had a level of competence in the activity that is being outsourced. Whilst Lankford et al. (1999) refer to external third party sources, Arnold (2000) refers to another perspective whereby outsourcing can apply to internal independent business units or joint ventures known as Internal Outsourcing.

In addition to those identified by Baines et al. (2000), Corbett (1999) summarises, "Outsourcing is nothing less than the wholesale restructuring of the corporation around core competency and outside relationships".

From the above summary of definitions, one can observe that the term outsourcing can be simply summed up as the provision of products or services by a separate organisation.

2.3 What to Outsource

"I Keep Six Honest Serving Men. Their names are

What and Why and When. And How and Where and Who……."

Rudyard Kipling (1900)

Rudyard Kipling's words also adopted by Plenert (2002) relating to strategic alliances provide a literary and entertaining check list to ensure that the major questions have been analysed regarding outsourcing. The questions what, why, when, how, where and who will be followed as a check list in order to capture the main elements associated with outsourcing.

Cost and expertise in the form of core competency appear to be the main drivers for outsourcing and should therefore play a great part in determining what to outsource. This point has been made by Arnold (2000) where he focused on these aspects using a transaction cost economics and a core competency approach to aid the outsourcing decision but in order to do this the potential outsourcer must first of all ascertain its own core competency. The following is a review of literature conducted to understand what to potentially outsource through the identification of a company's core and non-core competency.

2.3.1 Generic perspective of core/non-core competency

A review of literature uncovers many views on the definition of Core or Non-Core activities:

Alexander et al. (1996) provide a list of four meanings commonly associated with a “core activity”

(1) Those traditionally performed in house

(2) Those critical to business performance

(3) Those that create current or potential competitive advantage; and

(4) Activities that will drive further growth, innovation, or rejuvenation

"Those traditionally performed in house ", may be relevant and could be applied potentially to both Core and Non-Core competency. For example, Ford Motor Company used to manufacture almost 100% of the total vehicle at one time including the processing of raw materials associated with the products (Womack et al. 1990). Ford, however, would be unique nowadays if it continued with these activities which cannot still reasonably be considered traditional to an OEM. Whilst traditional activities may be relevant, they do not provide a clear direction in definition.

"Those critical to business performance" provides a more tangible definition and is directly associated with "those that create current or potential competitive advantage" and "activities that will drive further growth, innovation, or rejuvenation". All of these performance characteristics are linked into the strategic direction of a company and are based upon activities that provide the impetus for future success.

Kruger et al. (1997) stated that core competency combine three elements

1. In the eyes of the customers their characteristics must be relevant. They differentiate between the company and its competitors.
2. To gain competitive advantage, resources and know-how for the product must be unique over time. It must be possible to protect it against imitation by competitors over time. So a competitive advantage must be sustainable
3. Only if these resources are usable for multiple purposes, they are core competency and should remain within a company and should not be outsourced.

Again, elements 1 and 2 are in accord with Alexander et al. (1996) but go a little further in associating the uniqueness of the core competency.
Point three, associated with multiple purpose resource provides issues that may be in contrast to Kruger et al. (1997) and is not clear on why core resources should be usable for multiple purposes, especially if the competency is providing a sustainable competitive advantage.
Quinn (1995) provided a more detailed breakdown of core competency:

- “Core competencies are first and foremost skill- or knowledge-based, not product-based".
- “Core competencies are defined as platforms and are therefore capable of evolving"
- “Core competencies are limited in number"
- “Core competencies must be in areas that are valuable to the customer"
- “A Core competency must be in an area where the company can control and dominate through its resources"

- “A core competency should be embedded in a firm's culture, not housed in the heads of one or two of its leaders"

Quinn’s points 4 is aligned with Kruger et al. (1997) with a reference to customers and 5 is in accord with both Kruger and Alexander et al. (1996) emphasising the importance of competitive advantage. Point 2, whilst appearing to be a new element, is in fact related to the "sustainability" and "growth" by the two fore-mentioned authors. Whilst points 1 and 6 should not be dismissed they emphasise the point that core competency must be real within an organisation and not assumed. A highly successful end product, highly desired by customers may not automatically mean that the internal organisational that realised the product may necessarily have the skills necessary to continue the success of the product.

The three references provided by Quinn (1995), Kruger et al. (1997) and Alexander et al. (1996) provide an overview of researched viewpoints. Whilst not being totally identical, they do provide a clear indication that they are broadly in accord. Additionally, also in accord but providing a more concise description, Lonsdale (1999) provides a summation indicator stating that "the firm should draw its boundary around those skills and capabilities that are responsible for its competitive pre-eminence".

An important factor, covered in all is recognised with a view to the future providing the possibility that core activities may need to change and evolve. Similarly, because outsourcing is seen as an opportunity for the future, one must also be aware that core activities may need to adapt to change in order to survive as a competitive company.

The last definition comes from Alexander et al. (1996), “those (non) critical to business performance” and “those that (do not) create current or potential competitive advantage", This latter scenario is exemplified in the extreme by Quinn (1995), citing the fact that Nike, the largest producer of athletic footwear in the world does not manufacture a single shoe!

2.3.2 What to outsource: Specificity

Williamson (1989, 1991) and Lonsdale (1999) introduce a further factor to be considered in outsourcing known as specificity. Specificity refers to either assets or human resource (capability) that are highly specialised i.e. with a high level of uniqueness to a particular organisation. This specialised factor being one where capital equipment or resource is highly tuned to a customer’s requirements and would need redesigning or relocating in order to function for someone else. Both Lonsdale and Williamson suggest that only goods/services with low specificity should be outsourced, retaining high specificity goods in house. This viewpoint could effectively become a block on other viewpoints in that product or service deemed non-core and suitable for outsourcing could be viewed as unsuitable from Williamson's perspective if specificity was high.

Both Lonsdale (1999) and Arnold (2000) have elaborated on specificity by reflecting it as a key element in their respective outsourcing models. Arnold's model identifies the deep core aspects as having high specificity with non-core, correspondingly low. The example of Quinn (1995) relating to Nike not making shoes would comply with Arnold's model. A similar case of a total de-materialized company was cited by Woodruff et al. (1996) with an example of

Volkswagen's Resende plant in Brazil, owned and manned by seven key suppliers.

Arnold (2000) and Williamson (1989 & 1991) agree that the relationship between core and specificity is relevant and should be assessed in any core/non-core decision. By definition, if something is highly specific to an organisation it must be aligned to the uniqueness of the company's final product and therefore more likely to be involved within a core competency. Alternatively a non-organisationally specific commodity or service related competency would likely be a non-core and a likely candidate for outsourcing.

2.3.3 What to outsource: Summary

It is evident from the research that the "what to outsource" is clearly defined as services and products that are non-core to the outsourcing organisation (Arnold, 2000) and although this is supported by other leading authors there is some disarray in their final definitions of either core or non-core. Whilst it is important to know both core and non-core competency within an organisation it is only non-core that would be outsourced and therefore it is the latter that would provide the basis for further examination within the Thesis.

Table 2.2 shows a list of the resultant non-core competency identifiers from the reviewed literature. Each definition is aligned with appropriate references supporting inclusion.

The identifiers are not in any particular order of importance at this point but provided to capture those within academic and industry literature.

Table 2.2: Literature Summary of Non Core-Competency Identifiers

Non Core-Competency Identifiers	Reference
Low Specificity	Williamson, (1989, 1991) Arnold (2000) Kruger et al. (1997) Lonsdale (1999)
Greater External Expertise	Quinn (2000)
Expertise non-strategic	Alexander et al. (1996) Kruger et al. (1997) Quinn (2000) Lonsdale (1999)

2.3.4 Non-core competency: Principal criteria and potential metrics

The non-core competency identifiers presented, whilst providing concise definitions need further clarification into understanding how they can be more clearly established. In order to accomplish this, the individual identifiers illustrated in Table 2.2 were further analysed to establish means of ascertaining absolute identification through quantitative or qualitative measures.

2.3.5 Non-core competency drivers: Greater external expertise

In order to ascertain quantitative metrics it is necessary to look at other aspects relating to expertise.

Menzel, (2007) stated that innovations today require unique technical knowledge combined with social knowledge in order to be meaningful and useful. Within the context of modern industry whereby technology is moving rapidly it must be

reasonable to link expertise with innovation in that special skills or knowledge are being applied to provide new solutions.

2.3.5.1 Research and development related to innovation

Parasuramen et al. (1983), Franko (1989) and Morbey (1989) identify research and development (R&D) budget as the best measure of innovation as firms with their own development capability are likely to be more innovative. However an examination of product development resource metrics comparing US and Japanese suppliers ranging from system tier ones down to low-tier suppliers showed little difference in capability related to percentage of dedicated R&D heads compared to total company population (Liker et al. 1996). This is in contrast to Cozzarin (2006) who identifies a direct relationship between past economic performance and innovation. Despite the conflict of previous opinions it must be expected that innovative freedom will be greater in companies that have greater R&D budgets (Veerker et al. 2004).

2.3.5.2 Patents related to innovation

Pakes et al. (1984) provided evidence for patents as an alternative measure of innovation. Similarly Liker et al. (1996) identified a correlation between the degree of specialisation within companies and patent activity. Although patents appear to be a useful metric, it must be noted that regional splits are identified due to the relative high expenditure involved (Liker et al. 1996) and differing regional protection rights (Allred et al. 2007).

The conclusion that can be drawn from the analysis is that with regional variation playing a major part in determining a level of expertise (innovative advantage) patents can only therefore be used as a decision influencing metric if the suppliers and outsourcer are from the same regions in order to balance results uniformly.

2.3.5.3 Benchmarking

In cases of outsourcing whereby patents are not relevant it may be necessary to look at the benchmarking process to determine the relative level of expertise of a potential supplier to an outsourcer.

Two definitions are provided in order to establish the relevance to ascertaining expertise levels within organisations:

"Benchmarking is the continuous process of measuring products, services, and practices against the toughest competitors or those companies recognised as industry leaders" (Kearns, 1986)

Benchmarking is the search for industry best practices that lead to superior performance (Camp, 1989)

Both definitions clearly identify that benchmarking is relevant to the subject in that it can provide metrics of products and services in the context of establishing who and what is the best level. This process is very flexible and applicable to both internal and competitive organisations (Peterson, 1992), an important aspect in that an outsourcer should establish a performance comparison with its supplier.

Benchmarking appears to be a well recognised and used process with little variation shown between authors regarding its application and therefore it appears to provide the most appropriate measure of expertise to use generically.

2.3.5 4 Greater external expertise: Summary

Of the three potential methods of substantiating a suppliers greater expertise reviewed it appears that all are valid although some caution would be necessary regarding patent activity due to regional comparisons identified by Liker et al. (1996), Allred et al. (2007) and Pakes et al. (1984).

Whilst Research and Development budget may be indicative of these characteristics (Parasuramen et al. 1993; Franko, 1989; Morbey, 1989) it can be misleading through company size differences (Cozzarin, 2006).

Whilst the benchmarking exercise may provide the most comprehensive measurement of expertise, it would be potentially the most expensive of the three methods discussed.

2.3.6 Non-core competency identifiers: Expertise non-strategic

Whether or not expertise relating to an outsourced entity is strategic or not is very difficult to determine unless it is mentioned or reflected in a way that is made clear for all to see. It may be that a strategic direction relating to expertise may be indicated in the persona of a company within its core values, company mission statement or media releases. If a company is looking at outsourcing a particular entity the enablers for this are governed by the management who in

turn are also responsible for the company strategy (Mintzberg et al. 1985). It would therefore follow that this outsourced entity must by definition be non-strategic.

One characteristic that a potential outsourcer may exhibit is a reduced expenditure on Research and Development (Lynch, 1997). Therefore even if the company has not defined a specific strategy for an entity it may be evident in its Research & Development budget.

2.3.6.1 Expertise non-strategic: Summary

The following are two conclusions that may be drawn relating to expertise being non-strategic with respect to an outsourced entity:

1. Company strategy is determined by its management and if it decides to outsource an entity, the expertise relating to the entity, by definition must be non-strategic.
2. A reduction in R &D budget relating to a particular expertise may be an indicator that the expertise is non-strategic.

A defined corporate strategy should provide the best indicator regarding "Expertise non strategic" although in the absence of any guidance relating to the specific outsourced entity, one must look into other high level corporate statements for evidence using mission statements as an example. Typically they provide an insight to the deeper corporate philosophy and indications of company strategy relating to a potentially outsourced entity.

2.3.7 Non-core competency identifiers: Low specificity

Specificity criteria established by Lonsdale (1999), Arnold (2000) and Williamson (1989, 1991) are broadly in agreement with each other regarding potential guidelines for high or low specificity although perhaps the clearest descriptions and hence guidance for evaluation comes from Arnold (2000) and Williamson (1989, 1991).

Low Specificity: Can be governed with an external outsourcing design with minimal information transfer between partners.

High Specificity: Goods and services with high specificity cannot be used in other transactions without huge additional costs. Much information needs to be exchanged before, during and after exchange of service/goods. Limited, or perhaps even only one potential customer for service or product.

Table 2.3 illustrates the fore-mentioned key characteristics with indicative proportions of each related to indicate whether or not a service or product has high or low specificity. It provides a very simple tool for quickly providing an indication of level of specificity and hence to whether or not a product is suitable for outsourcing.

Using the automotive industry as an example, nowadays even the cheapest cars are built to a high level of quality (Reitzle, 2000). Related to this, Haberberg et al. (2001) make the point that buyers now have a very strong negotiating

Table 2.3: Key Characteristics Defining Specificity

Outsourced Service/Product-	**High Specificity**	**Low Specificity**
Costs to use for other purposes	High	Low
Amount of potential customers	Limited	Many
Data transfer needed partner to partner	High	Low

2.4 Why Outsource

position. In order to tackle this problem competitors are looking at operational innovation that effectively "passes value to the customer" (Cox, 1999). One of these ways is through outsourcing as described by Quinn (1995), Quinn et al. (1990) identify that competitive success necessitates a focussed organisation that concentrates on the essentials, based upon core skills to deliver maximum value to the value chain. By focussing on core skills, an organisation not only optimises its performance but also reduces its fixed overheads enabling possible re-investment into the company with resultant increased performance.

Fill et al. (2000) endorses the views of Quinn adding the benefits of reduced investments, improved quality and efficiency with reduced internal administration problems.

Beulen et al. (1994) go further by stating that a company has a limited investment budget which must be invested in core business activities, the prime activity with which the company generates its revenues. "All subsequent activities are mainly supportive and should be outsourced". He identifies five

main drivers for outsourcing: quality, cost, finance, core business and cooperation (Appendix 4).

It is apparent that the outsourcing drivers are principally efficiencies based upon knowledge/expertise related to core competency with improved cost and quality providing the potential outcomes.

2.4.1 Benefits of outsourcing

A review of literature indicates the main reason to outsource is to improve efficiency with resultant financial advantage and reduced variable cost expenditure (Lonsdale et al. 1997). Lau et al. (1997) find a significant relationship between global outsourcing and profitability margin where they found that Chrysler's profit margin is four times higher than that of GM due to effective global outsourcing strategies through strategic alliances whilst Higgins (2001) notes that suppliers are bearing 75% of cost cuts demanded by OEMs.

According to Chalos, (1994) and Branda, (1999) increased costs associated with conducting non-core activities are providing a driver for outsourcing. Reducing the need for high-level specialist knowledge in-house (Stephan, 2000) provides the potential opportunity of reducing headcount with a resultant reduction in expenses (De Vries et al. 1997). Winder (1994) in quoting Dennis Virag of the Michigan based Automotive Consulting Group Inc makes the point that a supplier, when given design responsibility is able to improve quality whilst reducing costs through the design process.

The special skills within the supply base developed through broad experience with other competitors must provide some advantages but as Lewis et al. (1991)

point out, there is a trade-off between lower associated production costs and higher monitoring costs. Indeed, Sweet (1994) noted that many organisations with little control over their internal organizations see a legally enforceable contract with an external supplier as a way of keeping a lid on costs.

Takeishi (1998) makes a valid point in that outsourcing would not necessarily provide a sustainable advantage to an outsourcer over its competitors, principally because the suppliers would have similar co-operative relationships with other competitors (Takeishi, 1998)

Increased economy of scale provides a further potential advantage (Fill et al. 2000) although this normally applies to standardised components although. Manion et al. (1993) noted that this was not the case in a survey relating to information systems. Where a high degree of customisation (specificity) is required it may be more advantageous to produce in house, a view further endorsed by Arnold (2000).

In the survey of Elmuti et al. (2000) to establish the reasons to outsource (Appendix 5) followed by further analysis identifying achieved improvements over a one year period (Appendix 6), the highest ranking expectation of cost reductions provided some performance benefits for 63% of the respondents in the form of lower variable costs whereby percentages of actual improvements were in the order of 5-10%, less than half of their initial expectations of 20-25% savings. Within the survey, it was also reported that 69% of respondents indicated that savings and indirect benefits generated by outsourcing programs were greater than the cost of implementing these programs.

Elmuti et al. (2000) also established that quality, whilst being a major expected benefit provided the lowest. Referring to Appendix 5 and 6, Quality

improvement was seen as the second highest expected outcome due to outsourcing and in fact 60% of respondents indicated positive quality effects of up to 5%, although this was below their initial 5-10% expectation.
Confirming the above, Beulen et al. (1994) defined three of their five main drivers for outsourcing to include quality, cost, finance (see Appendix 4). Whilst this is included in Elmuti et al. (2000) respondents list it is not as comprehensive. Kakabadse, (2002) provides a very comprehensive list that provides overlaps to the above.

2.4.2 Why outsource: Principal criteria and potential metrics

In order to establish some key potential outcomes, the highest ranked positive outcomes by survey respondents provided by Elmuti et al. (2000), Appendix 6 were used in the ranked order presented as the basis for those to be included discussed further and substantiated. The only exception to this is Elmuti's highest ranked criteria i.e. Performance. Because the expected goals by respondents are all financially related it has been included as costs, further emphasising the expected economic aspects of outsourcing. In order to eliminate unnecessary words and descriptions within the ensuing text, the descriptions will be abbreviated and made more generic, however they will represent the same meaning Elmuti et al. (2000) originally intended.
Since this survey was based in all major global locations and applied to both service and manufacturing organisations of varying size it provides a good representation of the likely benefits of outsourcing from a generic perspective.

In addition to this, it must be noted that many of the reasons are often interdependent, for example a presence in a foreign market may also provide new resources and also reduce costs. It is important therefore that no objective is looked at in isolation as it may carry advantages or disadvantages in another.

2.4.3 Why outsource: Costs

When establishing what cost should be included within potential positive outcome associated with "Why", it is important to use only costs relevant to outsourcing with the exclusion of things that will have to remain in-house. An example of this is overheads i.e. items which may also be used for other things or sunk costs on things that may remain dormant (Dury, 2001). Typically costs are within two major categories;

- **Direct Costs:** Assigned to a particular cost object
- **Indirect Costs:** Shared with no specific allocation

Using traditional cost accounting terminology these two categories can be broken down into the following;

- **Direct Materials:** Associated directly with product
- **Direct Labour:** Associated directly with product (Not to include supervisors or similar as these are covered as indirect labour.
- **Prime Cost:** Total of the above costs
- **Manufacturing Overhead:** Includes indirect materials and labour. Manufacturing overheads normally cannot be directly linked to products and therefore they are typically estimated (cost allocated).

- **Total Manufacturing Cost:** Includes all the above.

The definition of costs from Dury et al. (2001), adds the importance of considering time during the measurement of costs.

"The planned unit cost of the products, components or services produced in a period. The standard cost may be determined on a number of bases. The main uses of standard costs are in performance measurement, control, stock valuation and in establishment of selling prices"

The above statement is very important as the costs of a product may vary over time due to demand, efficiency of manufacture or many other reasons. Figure 2.3 illustrates an example of how costs change during the development and implementation of an information security system (Warren Axelrod, 2004). The development stages provide a significant financial burden on a company at the beginning of a project with benefits only coming later. Whilst the example is not

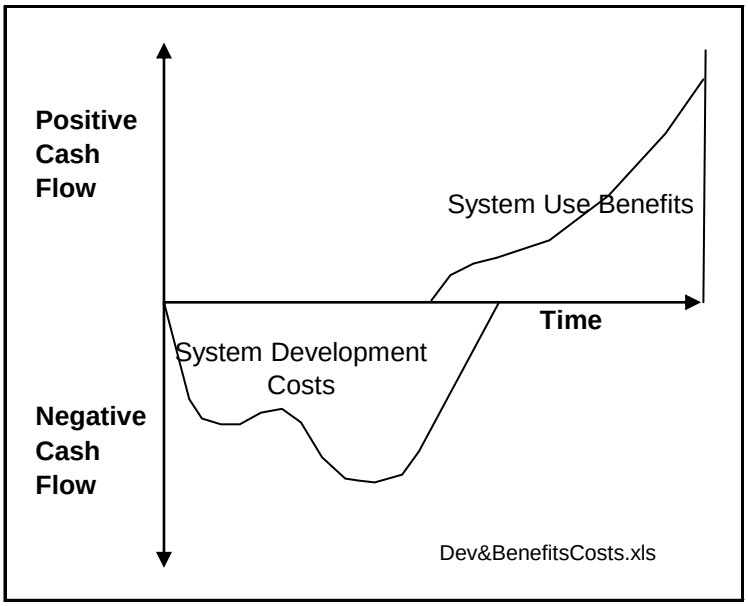

Figure 2.3: System Development Costs and Benefits Related to Information Security System Development Process (Warren Axelrod, 2004)

generic and actual cost variations may differ from other products or services, it does show clearly how costs can change over time, emphasising the point of Dury (2001).

2.4.4 Why outsource: Quality

In order to ascertain the benefits of improved quality one must understand what quality means. Quality means different things to different people. The ASQC/Gallup (1991) survey shown in Appendix 7 identifies a great variation in regional perceptions in quality and factors that influence their buying decision. Despite this variation it appears that consumers do each have a perception of quality that is important to them therefore it is important to establish the expert view in order to provide clarity.

Within the definitions provided by Kolarik (1995), below it appears that the experts also apparently have different view from not only each other but the consumers as well.

- Quality is fitness for use (Juran, 1989)
- Quality is conformance to requirements (Crosby, 1979)
- Quality should be aimed at the needs of the consumer (Deming, 1986)
- Quality is the loss (from function variation and harmful effects) a product causes to society after being shipped (Taguchi, 1986)
- Quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs (ISO 9000, 1992)

Bendell et al. (1998) sum up normal customers and experts with the following "Used in its traditional way, quality has often been used to denote excellence, beauty or high cost" – "A more useful definition of quality is meeting the requirement of the customer." This summary is clearly in agreement also with Monroe-Faure et al. (1992); "To succeed in today's competitive market place a company must supply products and services in accordance with customer's requirements and at minimum cost"

All experts without exception do agree whether in direct words or implication that quality is aimed at the end customer and therefore it follows that metrics used within an organisation to reflect end-customer quality should be used as a basis for measurement within an outsourcing decision.

Whilst the definitions of experts and customers may appear different they are really in accord in that the expert definitions effectively aim to cover those provided by normal customers. The less obvious common definition relating to "Well known name" is really based upon direct or indirect positive past experience of clearer defined quality aspects as it is highly unlikely that a customer would rank highly a well known name associated with a product ranked lowly in other quality aspects.

2.4.5 Why outsource: Exposure to technology

The repetitive cycle of technology evolution depicted by Hambrick et al. (1998) identifies that technology is constantly changing with incremental changes potentially leading to major shifts. Simchi-Levi et al. (2000) when discussing

strategic alliances make the point that partnering with a firm that has an important expertise enables the parent company to address related technical issues in a more competent manner. As an example, Microsoft, in order to benefit from local manufacturing expertise, moved its research activities to Cambridge (Simchi-Levi, 2000).

2.4.6 Why outsource: Delivery and reliability

Late deliveries and poor quality can severely disrupt operations, driving up inventory, cycle times, schedule variations and associated costs (Ruffa et al. 2000). An example of this is Boeing who in 1997 announced a "write off" of $2.6 billion due to shortages and productivity inefficiencies (Wall Street Journal. 1997).

Waters (2003) makes the point that suppliers should "deliver reliably, on time with short lead times" and using logistics as an example comes up with some potential benefits. Good logistics reduces stock levels (inventory) and related costs freeing up cash for other purposes and potentially increases sales by making product more readily available.

2.3.7 Why outsource: Gain resources

Elmuti et al. (2000) describes this as gaining the benefit of resources that are not available and uses the example of a way of countering an outsourcing company's inability to hire employees. In fact resources and therefore potential benefits cover a greater array than those mentioned by Elmuti. Azzone et al. (1995)

described critical resources as those that are “scarce, defendable, difficult to market and initiate and hence usable as the basis for long term competitive advantage”. He goes on further by categorising them into four groups and provides some examples of each;

- **Technology** – patents, manufacturing processes, registered designs.
- **Brand** – customer awareness ratings and customer retention rates
- **People and organisation** – quantity of skilled employees
- **Capital** – company assets.

Whilst technology has already been mentioned as a potential outsourcing advantage by Elmuti et al. (2000), it is interesting to see it mentioned by Azzone et al. related to resources. This actually shows as mentioned previously that many of the elements listed are somewhat interdependent, further exemplified by Simchi-Levi (2000) who also make the point that strategic alliances do provide the opportunity to gain a particular expertise to overcome technological challenges.

Using the Elmuti et al. (2000) example relating to employees it is clear that the most common perception of resources is related to people i.e. human resources. Macpherson (2001) breaks human resources down into three areas and provides some potential metrics;

- **Functional:** Employment efficiency and effective turnover, cost per hire, grievances.

- **Operational:** Revenue per employee, operating cost/term, recruiting costs relative return on investment (ROI), results of benefits packages, diversity programmes
- **Strategic:** Demographics, current staffing against future needs

2.4.8 Why outsource: Access to materials

Similarly to gaining resources or new technologies, an organisation may be able to gain greater access to materials by sourcing to a company that already has them. Materials could potentially fall into the realms of intellectual property or raw/final product materials although the latter would more logically be included within technology.

2.4.9 Why outsource: Presence in a foreign market

Simchi-Levi et al. (2000), when discussing strategic alliances makes the point that a benefit of producing in a particular region may be improved advertising with increased access to new market channels. A presence may also provide a way of overcoming the costs associated with import taxes/tariffs (Renert, 2002).

2.4.10 Why outsource: Market flexibility

Uncertainty in markets is prevalent in modern day industries. Customers are constantly changing preferences whilst brands are competing in a crowded market (Fassnacht, 2007). Product market flexibility: “The ability of product

markets to act as an adjustment mechanism to accommodate shocks and long term structural changes in the economy", (Scopulus, 2008) is a potential advantage of outsourcing due to the enhanced independence resultant from divesting the organisation of non-core tasks.

2.4.11 Why outsource: Skills/knowledge rationalisation

Outsourcing or indeed any other strategic alliance allows the pooling of knowledge to overcome barriers and explore new opportunities (Simchi-Levi et al. 2000) which may be of particular benefit when associated with rapid changes in technology.

2.4.12 Why outsource: Capital funding re-allocation

Any form of change in business direction provides the opportunity to re-allocate funding previously associated with the task involved. Outsourcing does provide this opportunity also although there may be some risk in immediately re-assigning all the associated capital as some may be required to mitigate the risk in future if the outsourcing goes wrong. It is therefore important that this is related to outsourcing "when risk intensity is low" (Quinn, 2000)

2.4.13 Why outsource: Competitive position

Plenert (2002) provides an interesting explanation of this aspect illustrated by a simple chart based upon "the law of comparative advantage", Table 2.4. The

chart is the basis for his explanation and provides a comparison of the cost of labour and a simple product, an apple, in the United States of America and Mexico.

Table 2.4: Chart to Explain the Law of Comparative Advantage (Plenert, 2002)

	Labour Costs	**Apples**
United States	$25/hour	$0.30
Mexico	$1.50/hour	$0.25

Despite the example indicating that both apples and labour would best be provided by Mexico it also shows in real terms it shows that USA produces apples more efficiently. Plenert makes the point that international competitiveness is driven by technical considerations and that the United States is the leader in 11 of the world's industrial sectors with Japan providing leadership in the remaining 2 and that the United States whilst being an excellent innovator is not so good as turning ideas into products. The Japanese however are the opposite and excel at manufacturing. Other advantages in competitive position may arise from sourcing in countries that have stable inflation rates, a foothold in emerging markets and lower trade balance obstacles or import tariffs. For example companies exporting to Europe must have European based production facilities in order to avoid tax tariffs (Renert, 2002).

The conclusion from the fore-mentioned examples is that outsourcing can provide an advantage by capitalising on generic competency and governmental policy that may be available in other regions of the world.

2.5 When to Outsource

Research has identified that external influences may dictate the optimal time to initiate an outsourcing initiative. The following indicators of "When to outsource" also illustrates some advantages and disadvantages. According to Quinn (2000), there are seven drivers as to when it is appropriate to outsource. These drivers will be used as a basis for further discussion in the following chapters.

When supplier margins are limited Here, Quinn (2000) view seems to indicate that if a supplier is working on a limited margin, i.e. presumably less than the outsourcing company's it would be advantageous to outsource and therefore either capitalise on this and provide relief on internal resources tied up with a task providing little profit via sales. There is a contrasting view as shown in the following example; Taking into account 2000 Financial results of OEM Ford related to two key suppliers, Ford attained 3.7% (Morningstar, 2009) compared to 1.5% for Visteon, (Visteon (2000) and 8.3% for Textron (Textron, 2000). Whereas Visteon may possibly meet Quinn's (2000) criteria, surely an alternative view may indicate that based upon equal cost submissions, Textron may be a much more favourable alternative on the basis that they are operating at higher efficiency as indicated by the higher return on sales.

Arnold (2000) identifies that a lower specificity product typically means that the external purchasing opportunities are increased which. This in turn provides greater competition hence lower margins. Since specificity has already been discussed, this Quinn (2000) point is already been taken into consideration.

When Markets are efficient is backed up with a comment that "In truth, markets are never totally efficient, so the best outsourcing opportunities occur in the markets closest to this extreme where there are numerous suppliers in competition with each other" (Quinn, 2000). Again, market efficiency can be linked with specificity in that greater efficiency can be obtained when specificity is low.

2.5.1 When to outsource: Volatility is high

Tyson (1998) in talking about the 21st century provides many examples of potential issues, commenting that rate of change will constantly increase with environment and energy becoming major issues. Hambrick et al. (1998) at an industry level states that the most important changes in industry are caused by the emergence of global competition, new technology and public policy. Both identify that volatility will effect many organisations over the coming years. Outsourcing when volatility is high is highly justified as it provides a risk sharing element with the suppliers.

2.5.2 When to outsource: Fast moving technology

Quinn's (2000) fourth point is exemplified by fast repetitive iterations of new technology in parallel with increased costs. According to Hambrick et al. (1998), technology constantly moves and changes through given cycles. Typically a product goes through a cycle of evolution that finally ends when there is new technological momentum caused by new architectural innovation with the

simpler moving at the fastest rates. This turnover of technology can provide a large drain on financial resources within an organisation and outsourcing or some other form of partnering may provide a way of reducing the burden of risk and development costs.

On the basis of the above comments and assuming that the technological moves are in areas of non-core activity, Quinn's (2000) opinion is valid.

2.5.3 When to outsource: High internal costs

Leuliette, (2002) stated that the "traditional Big Three" (GM, Daimler Chrysler and Ford) are "high-cost producers, and carry cost penalties in management overhead, labour and benefits", further adding. "The big 3 cannot return to their past glory by having the supply community financially subsidize their inability to address their own problems" Quinn's (2000) point needs no further explanation other than that the cost must be high relative to the supplier to be fully justified. Quinn (2000) points out that most companies despite providing a large focus on externally sourced costs have little knowledge of their own internal costs. Despite this Quinn's (2000) driver regarding when to outsource is clearly valid.

2.5.4 When to outsource: Risk intensity is low

Quinn (2000) suggests the best time to outsource is when it is possible to outsource in steps, when there is a possibility to reverse the initiative or when there is a sound fall back plan.

From the perspective that outsourcing like any other strategy has the potential to be a failure it is highly likely that an organisation would want to consider it without some form of backup plan. Therefore, the comment is justifiable.

2.5.5 When to outsource: Chance of strategic block.

Slack et al. (2002) makes the point that market forces that have made a supplier successful also typically make them more profitable. Outsourcing could ultimately have a negative effect on the outsourcing company to the extent that its long term sustainability may be weakened. Two examples of the Slack' et al. comment are provided by Simchi-Levi et al. (2000):

- Toshiba manufactured copiers for 3M but is now a supplier of their own Toshiba branded copiers.
- Hitachi once manufacturing under licence for Motorola now makes its own microprocessors

Quinn (2000) defines the strategic block as an intellectual competency that is not available to the supplier, which effectively minimizes the risk of the supplier gaining any strategic ground over the OEM. Effectively this strategic block

would be an intellectual core competency that provides a direction for an outsourced non-core activity.

A clearer definition here would be that the outsourcer should only outsource if key controlling competency are retained in-house in order to stop the supplier from becoming a potential competitor.

2.6 How to Outsource

Whilst some discussion regarding the "how" to outsource has been provided, the depth of investigation and field of expertise is not within the remit of this Thesis but it is clear that the control of the outsourcing process can play a major factor with the ultimate success of the outcome.

Without going into the depths of how to run a business, the process how to outsource must be viewed as a combination of the key elements within the outsourcing process i.e. the elements relating to the managing of a business that are unique to the outsourcing process.

2.7 Where to Outsource

Dobler et al. (1990) suggest that "where" to purchase is potentially one of three geographic areas, each providing certain advantages and disadvantages. Dobler et al. (1990) logically covers buying locally, nationally and internationally, each of which carries potential advantages which have been identified in Table 2.5. Obviously for a potential buyer, the most desirable advantages would be selected although it is more likely that a company may capitalise on other synergies such

as similarly located production facilities in order to capitalise on reduced logistical costs.

Table 2.5: Where to Outsource

Where	
Buying Location:	Potential Advantages:
Local	Close co-operation due to geography Delivery more certain as transportation effect is minor Lower prices can result due to consolidated transportation Shorter lead times (JIT – Just In Time) Rush orders likely to be faster Disputes resolved easier Implied social responsibility to community is fulfilled
National	Often higher quality/better price through economies of scale Often supply superior technical assistance Greater production capacity and therefore greater capability in handling fluctuating demands Less shortages due to broader markets
International	Much variability due to individual location's performance but some advantages; Quality Timelines Cost New technology Broadening supply base Counter-trade

Other aspects for buying internationally are financial incentives and the benefits of highly educated workforces as exemplified by Hong-Kong and Malaysia, possibly benefitting from a potential for the outsourcing organisation to learn from an educated workforce with a particular expertise for certain tasks (Plenert, 2002). Alternatively, in order to capitalise on a technology change, sourcing to a region with a known reputation for rapid implementation of new production like Taiwan could be advantageous.

2.7.1 Where to outsource: Summary

Table 2.5 illustrated a summary of the potential sourcing locations (Dobler et al. 1990) with potential advantages. The list is logical and comprehensive and appeared to represent the body of literature reviewed.

2.8 Who to Outsource to

Globalisation has changed the world of business and increased competition amongst suppliers making them more aggressive for business (Chopra et al. 2004). Within the research so far the "who" aspect has been partially answered. From the perspective of establishing greater external expertise and having a perception of the potential advantages one must already have a good idea who the potential suppliers are. One must assume that beyond these, it is within normal business practices and criteria not necessarily associated within outsourcing that should dictate who to buy the outsourced product or service from. At this point, the literature review becomes more directly associated with who to outsource to including some guidance as how to find potential suppliers. Riggs (1997) through case study identified that suppliers fell into three groups (

- Suppliers with clear competitive advantage in cost or product uniqueness
- Suppliers with declining competitive advantage and products comparable to other marketplace offerings
- Suppliers with questionable competitive advantage but acquainted with a senior officer in the business.

The first two groups appear reasonable observations with the third clearly indicating a potential corrupt element. This potentially corrupt element may be true but clearly a supplier should be awarded business on real competitive advantages that should have associated metrics.

Bryson et al. (2004) describe difficulties in measuring expertise and offers the suggestion that an outsourcer should utilise suppliers that are known and trusted using repeat business and third party referrals as a good indicator, however if these are unavailable, another source of guidance would be necessary. Clearly the obvious choice to outsource to would be “Suppliers with clear competitive advantage in cost or product uniqueness”. In order to identify such supplier's data must be evaluated in order to establish who fits this description. Baily et al. (1990) provides a list of traditional evaluation criteria namely, quality, quantity, timing, service and price which whilst still provides insufficient detail into what to examine. England (1967) in his description of a good supplier provides an expanded list that includes a final note that a good suppliers interests are best served when he best serves his customers, an interesting aspect that is can be viewed as all encompassing. Baily et al.(1990) provides a more detailed and informative list of characteristics that should be measured to find a good supplier which also provides a great deal of alignment with England (1967)

Lonsdale (1999) identifies examples of supplier accreditation and performance criteria used by Hewlett-Packard (Appendix 9). Lonsdale’s criteria are generally aligned with those previously discussed but introduce technology as a category. Whilst this appears new, when taken into consideration with definitions of quality by Juran (1989), Crosby (1979) and those of normal customers;

ASQC/Gallup (1991) technology is very much linked to quality because it aims at satisfying the needs of the end customer.

It is apparent from the research that the fore-mentioned opinions relating to supplier selection are in accord both with requirements and potential metrics. Those criteria and metrics suitable to each outsourcing situation would comprise of a filtered list from those within this chapter.

2.8.1 Where to search for potential suppliers

Assuming the outsourcer has not had the benefit or experience of others to recommend potential suppliers (Bryson et al. 2004); there would be a requirement to use other search methods. Using the same criteria as for finding suitable competitors/suppliers for benchmarking purposes, Bendell et al. (1998) suggest using databases to find suitable companies, recommending particularly the Dialog service, "World's largest" which has access to over 450 databases. Chang et al. (1995) provide a comprehensive list of potential search methods which covers the body of literature reviewed.

2.8.2 Who to outsource to: Summary

In order to clarify who to outsource to, Table 2.6 was developed. The first column simply provides a list of potential sources of information to find a suitable supplier, a fairly comprehensive list provided by Chang et al.(1995) Supplier requirements, provided in the second column come from a collective list provided by academic and industry level papers alike.

Table 2.6: "Who" to outsource to

Who	
How to find Potential Suppliers:	**Supplier Requirements:**
Total quality orientation Trade magazines Industry publications Professional journals Market Research Government Studies Computer databases Telephone Mail Services Benchmarking experts and consultants Organisations specialising in benchmarking data	Financially, Technically and Production viability Ability to act as a full partner through all phases Openly share information (Requirements, cost and quality targets) Active in cost reduction and product improvement Ability to develop prototypes and production Prepared to agree cost targets Works jointly to increase flexibility on parts delivery Sound business sense and attitude Good track record in supplying the buyer's market Suitable technical capability and modern facilities Total quality orientation Cost effective management Effective purchasing (Acquisition and control) Good morale among work-force Effective logistical arrangements A customer service mentality

2.9 Risks Associated with Outsourcing

The outsourcing initiative requires a dependency on a third party, i.e. the supplier and therefore the supplier and related communication link may provide a new element of added risk. Importantly, as Arnold (2000) states, "the companies competitive advantage relies on supplier's abilities" and Elmuti et al. (2000) "outsourcing usually reduces a company's control over how certain services are delivered, which in turn may raise the company's liability exposures". Their

survey identified that both with successful and unsuccessful outsourcing, poor choice of outsourcing partners was one of the highest reported problems (Appendix 8). This may be attributed to some suppliers being unready for this challenge and rather than formulating long term strategies they are adopting short term reactive responses to customer demands (Oakes et al. 1999).

2.9.1 Loss of corporate knowledge and supplier opportunism

Suppliers have conflicting interest in maximising profits (Lacity et al. 1995) and Lonsdale (1999) comments that many firms complain of supplier opportunism, explained by Vining et al. (1999) when one party, in this case, the supplier, acts self interestedly. This can happen in the case of multiple suppliers pointing finger of blame when respective products do not align as intended (Smith et al. 1997).

Another potential manifestation of opportunism may occur at the conclusion of a successful programme whereby an expiring supplier having gained superior knowledge will not be able to feed this knowledge into subsequent programmes unless reselected (Lonsdale, 1999). To gain maximum benefit from an outsourcing situation, the outsourcer must be clearly aware of the risks of suppliers absorbing knowledge gleaned from a programme with all its potential implications, thereby suggesting that there may be some advantage in retaining some corporate knowledge of out-sourced activities.

Anderson et al. (2000), provide an example of a counter-opportunism force with the supplier's expectation of future transactions reputational consequences. Williamson (1979) suggests that opportunism is only a threat when there are a

small number of available suppliers, hence reinforcing the Anderson et al. (2000) argument in that with a large supply base, the outsourcer would have many opportunities to resource if they were unhappy with opportunistic activity. Globerman (1995) introduces the relationship between complexity and opportunism whereby the supplier through in depth knowledge of task complexity will have an advantage over the outsourcing company. Similarly Arnold (2000) identifies high specificity in designs as a cause for high outsourcing costs due to increased communication level.

Relating to this, Gamble (1995) in suggesting one of four questions before making an outsourcing decision asks, “What dependence on a third party will be created by outsourcing, and how vulnerable would the organization be if that third party somehow become unable to perform as expected?” Additionally (McCarthy, 1996) asked “If I outsource with a vendor, am I locked into that vendor or " how can I make a change in corporate direction and decide to in-source at some point in the future, or change to a second vendor?" Lonsdale (1999) poses the question how can an organisation counter the opportunism threat of a supplier who has retained more competitive knowledge than the outsourcer at the end of a programme? (Lonsdale, 1999).

To overcome the potential risk of supplier opportunism one must look at the potential of “contestability”, (Vining et al. 1999), within the outsourcing organisation, i.e. How to provide intelligent scrutiny of supplier claims and activities. The means to introduce contestability within the outsourcer is to either retain expert knowledge in-house, use external third party sources or admit defeat and revert to the initial situation by back-sourcing. Delaney (1999) suggests a company should retain an element of expertise in order to provide a

credible threat. Task complexity and difficulty in measuring task performance, two attributes associated with transaction costs provided by Milgrom et al. (1992) are clear examples whereby retained expertise could mitigate opportunism risks. Walker et al. (1984) observes additional factors that effect transaction costs are supplier market competition and uncertainty with final product volume and design changes. The first point, also made by Lonsdale (1999) recommends that great care be taken when outsourcing into a supply market that has a small number of suppliers in order to reduce potential for opportunism.

Further mitigation of opportunism may be achieved through multiple vendors (Quinn, 2000) whereby no single supplier has all the appropriate capabilities. An example of this is the dual-sourcing as practised by Hewlett Packard, (Lonsdale, 1999) whereby similar technologies are provided by competing suppliers such that each could be switched to or from at very short notice.

Research identifies that supplier opportunism is a clear risk to outsourcing success, particularly where there are few competitive suppliers to choose from. An outsourcer must fully understand the areas where they may be vulnerable and take suitable steps such as retaining internal expertise or introducing competitive suppliers to counter this.

2.10 Management of the Outsourcing Process: Contracts and Specifications

Clearly the discussion on supplier opportunism provides a logical lead in to the management process associated with outsourcing. It is also clear that in any

business activity involving external resources that some form of contract should exist that involves incentives and penalties. In fact

Burdon et al. (2005) with evidence from a survey saw that many companies view contract management is a core competency with further evidence supporting the view that management skills for alliance contracts were complex and hard to develop and implement. Fan (2000) in another survey identified that improvement of specifications and project management was the second most important factor following the supplier selection process. Sweet (1994) makes the comment, "When it comes to signing the contract, some companies are in danger of signing a blank cheque, they often feel it is too difficult to sort out exactly what should be provided in detail, and it is too easy for the suppliers to simply say trust the other side".

Contracts should anticipate all potential opportunism costs (Vining et al. 1999) and further reduce co-ordination costs (Williamson, 1979). Coase, (1937) goes further by stating that contracts should recognise strategies to address all potential contingencies. Crowley (1999) suggests that more planning that is done for risk factors prior to implementation provides a greater probability of success. Clearly, the drafting of a contract is potentially a daunting task exemplified by Lonsdale (1993) that contracts are often blank where uncertainty is greatest.

2.11 Employee Relations

Elmuti et al. (2000) reporting that even successful outsourcing companies identified that fear of change, including fear of job loss as the most serious problem facing global sourcing efforts. In accord with this, Malhorta (1997)

makes the point that global outsourcing can lead to a "decline in morale and performance of remaining employees". Managing through communication and honesty was found to be very important in dealing with these fears (Elmuti et al. 2000; Jones, 1997; Perrone, 1997; Quinn, 1999a; Fill et al. 2000).

In contrast to the potential fears exhibited by the outsourcer employees, the perspectives of supplier employees are understandably much more positive often behaving as if they are employees of the outsourcing company (Curtis, 2000).

Employee relations are highly effected by outsourcing and major cost factors should be considered as part of the decision (Quinn, 2000; Hall et al. 1995; Domberger, 1998).

2.12 Critical Review of Existing Outsourcing Models

Within the literature review, three models were identified that had potential to be used as a high level guide to outsourcing; however none was found that fully captured all necessary elements or could be used without additional detailed research. They all lacked a combination of comprehensive coverage of criteria identified within the literature and key characteristics that would enable their identification.

Arnold (2000) provided the most comprehensive model (Figure 2.4) which although targeting the outsourcing of design, covers important elements of what to outsource as revealed through research.

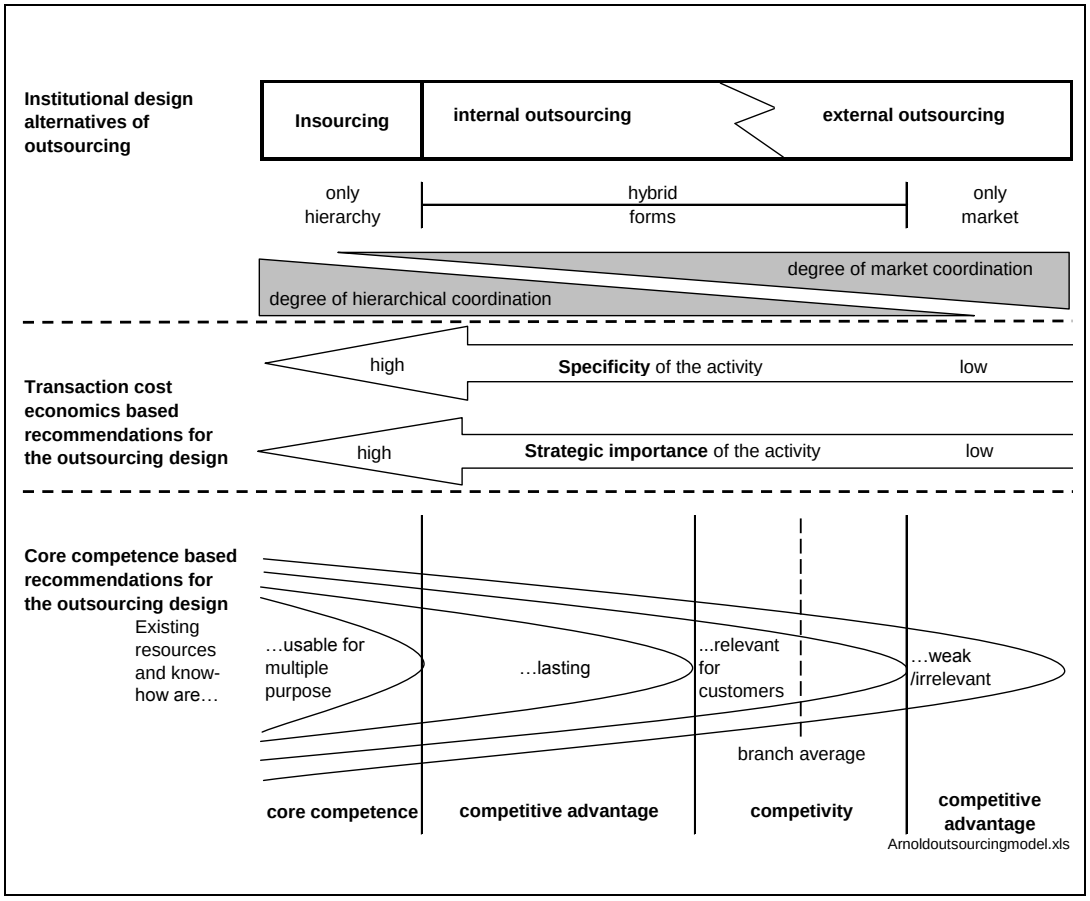

Figure 2.4: Model for Outsourcing Design. (Arnold, 2000)

Clearly Arnold has captured core competency and its importance to a company in accord with the views Kruger et al. (1997) and Lonsdale (1999). He has also captured specificity in further accord with Lonsdale (1999), Williamson (1989, 1991). Despite this the model overlooks the important aspect relating to risk mitigation through selecting the appropriate time to outsource (Quinn, 2000). Whilst reviewing industry life stages (Lynch, 1997) and the seven drivers (Quinn, 2000) it was identified that although the outsourcing option could be taken at any time in a corporate life cycle or set of conditions, it was likely that there were optimal times. Similarly the model lacks any reference to the importance of establishing objectives of outsourcing in order to understand why outsourcing should be implemented. In common with the other models, Arnold's

did not provide a format that was easily followed to test specific cases and appeared to be more an overview of related criteria than a practical tool. McIvor's model, Figure 2.5, "A practical framework for evaluating the outsourcing decision", provides a very high level overview of the outsourcing decision.

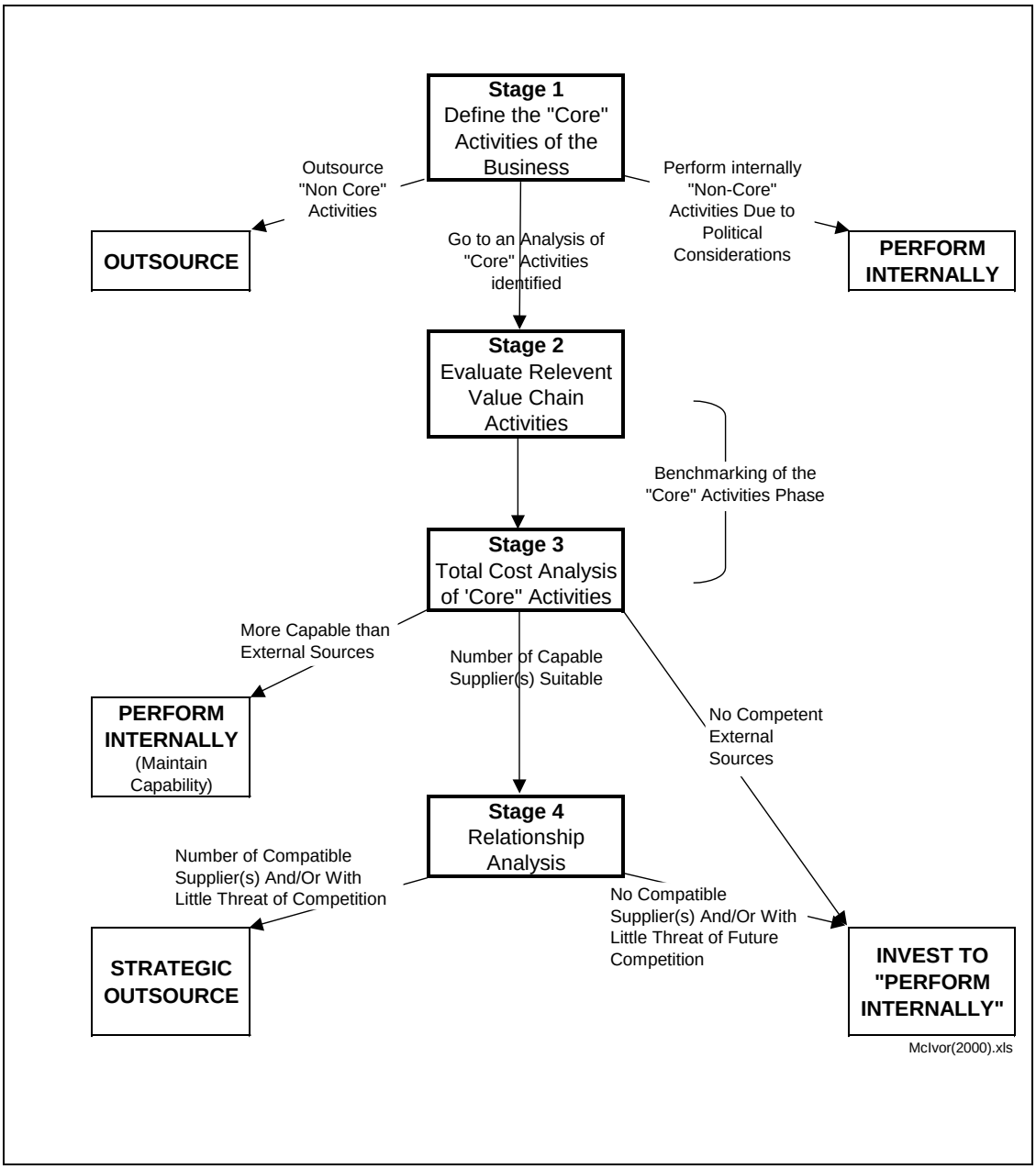

Figure 2.5: A practical framework for evaluating the outsourcing decision (McIvor, 2000)

For example whilst showing clearly that core and non-core activities are very important and must be established, there is no guidance as to how they should be defined. Similarly, although the important element regarding reasons to outsource is indirectly defined in Stages 2 and 3 through benchmarking of value chain activities, there is no guidance on what should be analysed and how. These stages also does not address that there may be other reasons to outsource. Elmuti et al. (2000) identified in a survey that other similarly important reasons to outsource were quality improvement and exposure to worldwide technology and delivery and reliability improvements, none of which are reflected n McIvor's model.

The model of Lonsdale (1999), "A Risk Management Model for Outsourcing" (Figure 2.6) whilst included in this discussion is not designed as an outsourcing decision model but was included because it did appear to cover some important aspects within it. Although "Core, Non-Core" or "Specificity" remains unmentioned anywhere on the Lonsdale's model, they are implied within the definitions, however similar to the other two models it is very much an n overview and designed to clarify a route for risk managing an outsourcing process.

Related to the models, further work provided by Beulen et al. (1994) and Quinn (2000) for example provided invaluable data for comprehensive guidance to a potential outsourcer; however the data was provided in elements as opposed to a total model and therefore was not suitable to be used for the case studies without the further work developed within this research.

The above is not a criticism of the various authors referred to within this text. All inputs were invaluable sources of information, however, the comments clearly

show that they were not suitable in their entirety for the purposes of this research.

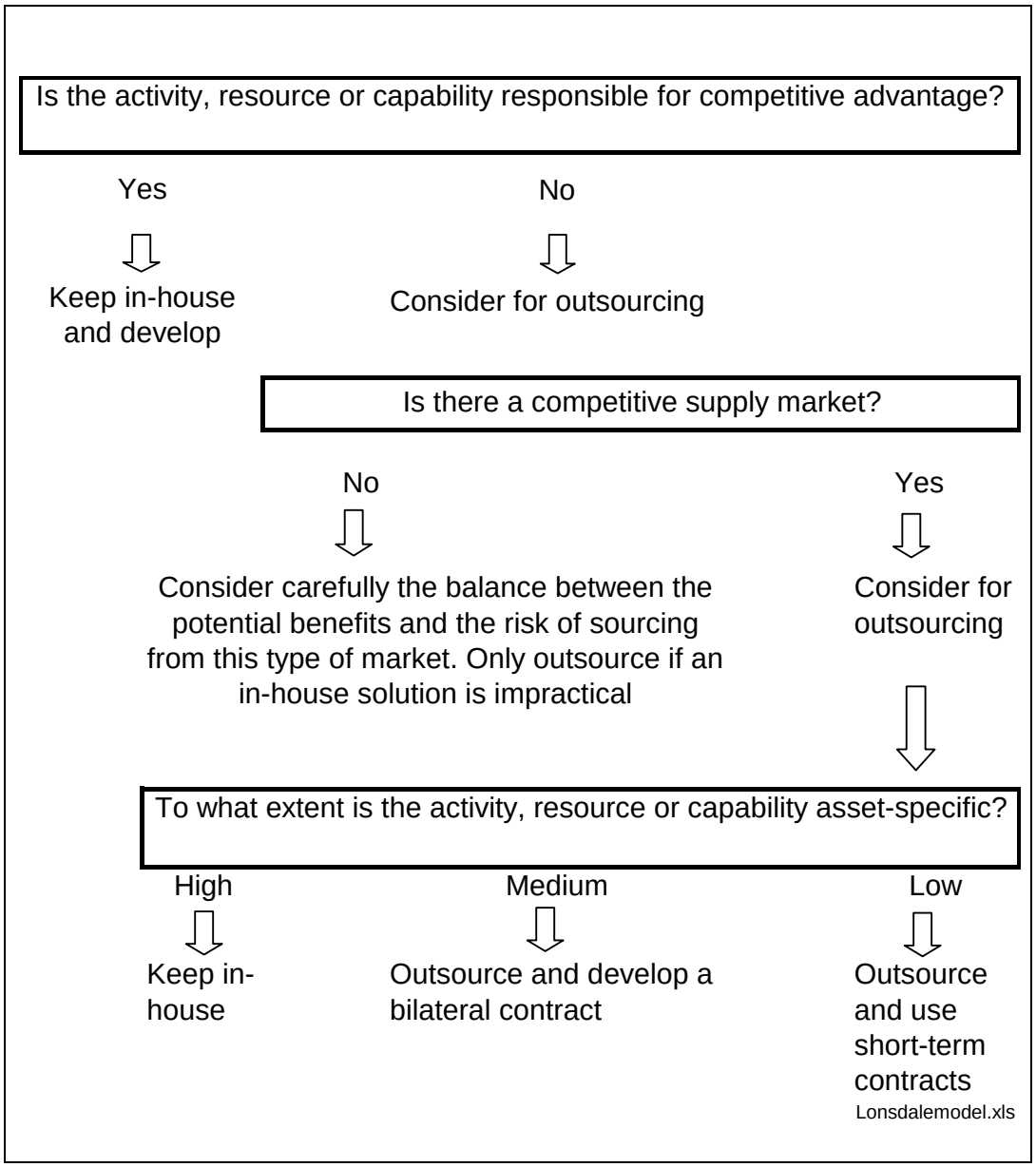

Figure 2.6: A Risk Management Model for Outsourcing (Lonsdale 1999)

2.13 Statement of Characteristics: Outsourcing as a Corporate Strategy

Some key points are captured here that were collected through the reviewed literature;

- Outsourcing is a potential strategy affected by the Global Environment but predominantly driven by the forces within the Industrial Environment it operates.
- It cannot be viewed as a strategy that will provide a sustainable competitive advantage as it is a strategy that can easily be copied by competitors.
- The strategy is one that can be utilised any time within the life cycle of an industry but it is more likely to be adopted in the Mature/Declining phases.

2.14 The Link between Specificity and Commonality

With respect to case study 4, it was necessary to conduct further research relating to the link between specificity and commonality and its relationship to outsourcing potential. The term "commonality" within the following discussion can be viewed as standardisation either at company or industry level. The review of literature relating to outsourcing poses many considerations regarding what to outsource and levels of specificity (Arnold, 2000), quantity of potential suppliers (Williamson, 1979) and the effect on final transaction costs relating to the potential pitfall of supplier opportunism. Additional considerations relating to use of outside suppliers are that of the push for component sharing and commonality of parts within an OEM all can have a bearing on the level of success in an outsourcing scenario. Commonality (standardisation) and specificity are very closely linked. One can only assume that reducing the specificity of a service or commodity can make it more applicable to an

outsourcing situation i.e. making it non-core. In reducing specificity, a service or commodity becomes closer to a standardised or commonised entity.
Some of these aspects will be discussed in the following chapter followed by a further case study (4) related to outsourcing of intellectual competency regarding one particular standardised commodity to two competing suppliers.

2.15 Commonality and Platform Sharing

"The cost of non-standardisation has been put at about $10 billion to the industry or $200 per car" (Kimberley, 2000). Probably the most well known drive for commonality (standardisation) is that of Volkswagen which currently shares 70% of parts across their platforms (Wards Auto, 2001). Peugeot are taking this further with a projected 85% commonality targeted for 2004 within their shared platform strategy (Automotive News, 2001a). Potentially the most efficient method of utilising the concept of commonality is to re-use existing components and reap benefits in reduced tooling, design, improved reliability efficiency and increased speed to market (Clark et al. 1991).
"The first step to profit from economies of scale is to standardise the parts bought from the supply market, e.g. use the same door handles for all car models" (Arnold, 2000). Siddique et al. (1998) define standardisation as the main concept behind platform engineering.
Economies of scale are beneficial particularly where tooling, plants and facilities are already available but this concept pushes one in the direction of a single supplier, in potentially one location. For large global OEMs, the likelihood of one supplier plant providing cost effective components for entire global

automotive manufacturing facilities is severely limited particularly where components are large and unwieldy and shipping costs may be prohibitive. Where there is a clear financial advantage to increase manufacturing capacity a situation arises whereby one can consider alternative suppliers even if they are making standardised components identical to a competitor.

The theory of outsourcing of lower specificity parts (Arnold, 2000) does lend itself to the theory of standardisation in that if an OEM requires a generic product e.g. a battery, tyre or roller bearing, should be outsourced along with the intellectual knowledge associated with the detailed design and specification albeit with some internal controls remaining. The components listed despite being of low specificity are in fact manufactured by many large well known suppliers to the industry. This identifies that standardised components can be effectively made by multiple suppliers and subsequently provide a competitive situation to the advantage of the OEM purchasing department.

2.16 Summary: Subject Matter Literature Review within Chapter 2

Chapter 2 has provided a broad overview of outsourcing with an investigation into the various environments it is influenced by and operates in. The effects of suppliers, customers and competitors as indicated by Porter's five forces all have the potential to influence an outsourcing decision and ultimately decide its success. Clearly there are benefits and risks involved with outsourcing, there are no guarantees that it will succeed. This additional research will provide an order and structural elements necessary to build a generic outsourcing model that will

cover key considerations and guidance into making an informed decision taking into account the risks and potential advantages.

The link between outsourcing, specificity and the modern trend of platform engineering, dependent upon commonality provides an added dimension to outsourcing that will not be developed further within this Thesis although the Author thought it important to point out the linkage. This linkage provides a useful hypothesis for further research in that by lowering specificity, commodities develop more commonality by definition which further lends itself towards platform engineering. It follows therefore that by re-engineering to decrease specificity in a commodity provides a positive edge to provide more competiveness through commonality. In addition the reduction in specificity also increases the scope for further outsourcing.

Chapter 3: METHODOLOGY

This Chapter covers the methodologies employed within this research including associated new literature review where necessary. The methodology will be covered in two parts, the first based upon the research process methodology and the second covering the methodologies employed within it.

3.1 Research Process Methodology

The preceding Chapter 2 covered the literature review based upon the aims and objectives defined in Chapter 1. The review built up a comprehensive knowledge of generic outsourcing including What, Why, When, How and Where and a review of existing outsourcing decision models in order to construct an outsourcing decision model that provided comprehensive coverage of researched findings.

3.1.1 Development of Synthesised Outsourcing Decision Model

Within the following Chapter 4, an outsourcing decision model was developed which was based upon What, Why etc. Each criterion was evaluated theoretically based upon the literature and ultimately excluded or included based upon individual merit. In addition, relevant criteria were populated with examples of potential metrics based upon further research. Within this process, in order to provide an order of importance of either criteria or potential metrics, Kepner

Tregoe analysis was used. Chapter 3.2.5 provides an in depth review of Kepner-Tregoe analysis.

3.1.2 Validation of Outsourcing Decision Model

In order to validate the developed outsourcing decision model it is important to establish that the selected means of validation is optimised in order to reflect academic rigour within the limited resources available to collect and analyse data. The model, in that it will be developed in the format that provide the basis for a workable "tool" with question/decision prompters and metrics provides a logical basis to be used within real case studies whereby the format can be followed and populated with real life data. This approach is supported by Stuart (2002) stating that case studies are much more likely to increase dissemination success. Nagel (1961), relating to operations management, further adding that they contribute to theory building in situations that have not been empirically tested, providing an approach that attempts to ground theoretical concepts with reality (Stuart, 2002). Potential criteria involved in an outsourcing decision provides many factors that could effect success over a period of time therefore it is important to consider as many as possible in order to understand those that may be most important. Voss et al. 2002 makes the point that in such circumstances retrospective case studies provide the means to provide evidence of success or failure.

In recognition that the likelihood was that case studies would be bounded within the Author's parent company, in order to ensure greater access to relevant supportive raw data, it was important to ensure that this did not ultimately

provide sub-optimal overall conclusions. Voss et al. 2002, suggests that for given resources, fewer case studies allow for greater depth whilst Mukherjee et al. 2000, make the point that single cases may allow several contexts to be studied. However, whilst few case studies may provide these benefits, Voss et al also is supported by Jick (1979) and Denzin (1978) in that triangulation with other case studies increases overall validity.

3.1.3 Case Study Validation

The following provides a summary of the main points derived from the reviewed literature above. It will provide guidelines to the selection and application of case studies as a means of validation within this Thesis.

- A case study approach provides potential for greater dissemination success through empirical research based upon real situations (Nagel, 1961 and Stuart, 2002)
- Fewer case studies allow for greater in-depth research with the possibility to address a greater quantity of contexts (Voss et al, 2002 and Mukherjee et al. 2000).
- Triangulation of results provides a means of strengthening results in situations where case studies are limited (Jick, 1979 and Denzin, 1978).
- Retrospective case studies are particularly effective in situations whereby success or failure are critical outcomes (Voss et al. 2002).

Based upon a combination of the above evidence and availability of resources, the following cases will be used to validate the research derived outsourcing decision model:

Case Study 1: Comparison of OEMs represented in case studies with three major competitors relating to the outsourced entity. This will also provide triangulation (Jick, 1979 and Denzin, 1978) with the findings of Case Studies 2 and 3 to consolidate validation.

This case study is carried out first in order to provide a broad illustration of the environment the subject outsourcer is working in. It does not provide the strongest validation as it will be based upon a theoretical review of evidence available within the public domain in alignment with the criteria presented in the researched outsourcing decision model.

Case Studies 2 and 3 provide the strongest validation as they provide the multi-context validation element described by Mukherjee et al. (2000) combined with strengthening of theoretical concepts with reality (Stuart, 2002). These two case studies will be used retrospectively (Voss et al. 2002) in order to utilise the outsourcing decision model in ascertaining whether or not criteria presented are successful in identifying a positive or negative outcome following a real life outsourcing situation.

Case Study 2: Validation of Outsourcing Model through investigation of the outsourcing of fuel filler pipe intellectual competency **(high specificity *end commodity*)**

Case Study 3: Validation of Outsourcing Model through outsourcing of fuel filler pipe intellectual competency **(low specificity *end commodity*)**

Although Case Study 2 and 3 are very similar, the relevance of outsourcing a potentially low specificity entity that relates to an already outsourced high or low specificity final end commodity was not uncovered within the literature review. Since it provides a new interesting facet that is easily validated it is included within this research within these two case studies.

Case Study 4: Investigate benefits of introducing a second competitor supplier into a single sourced outsourcing situation relating to case studies 2 and 3.

Subsequent to outsourcing Supplier opportunism provides an element of risk to the final outcome (Lonsdale, 1999 and Vining et al. 1999) which may be countered by the concept of "contestability" (Vining et al. 1999) countered through an additional supplier (Quinn, 2000 and Lonsdale, 1999). This provides the purpose of Case Study 4 where criteria identified within the researched outsourcing decision model are investigated in order to ascertain the potential benefits of bringing a second supplier into a single sourced situation.

Each case study was based upon real life fuel system cases within the Author's sponsor company Ford Motor Company. Fuel systems was chosen as it provided synergies with the Author's role enabling greater access to related data and expertise This further enabled a comprehensive validation of the developed outsourcing decision model. In some cases where information was not directly available, other methodologies needed to be employed in order to ascertain key criteria. These methodologies will be discussed case by case.

Methodology Case Study 1: Comparison of OEMs represented in case studies with three major competitors relating to the outsourced entity.

An indirect approach used in this case study to compare the outsourcing strategy of three OEMs (Volkswagen, PSA and Toyota) with Ford Motor Company with respect to the outsourcing of intellectual competency regarding fuel systems. Since in retrospect, this information was not directly attainable, other means needed to be employed.

The resultant strategies were determined based upon a study of relevant patent activity to determine the level of expertise (Pakes et al. 1984) in each company as a reflection of a set strategy. This work was conducted using MicroPatent's PatSearch Full Text Database whereby time based individual searches could be made at company or regional level using component or system key words as a basis for the search. These searches provided patent data at detail level such that they could be evaluated in-depth to establish their individual worth within the context of research.

This patent activity was also supplemented with an investigation into associated research budget as a means of identifying a strategy (Lynch, 1997).
The final aspect was to determine if a specific outsourcing strategy was captured either directly or indirectly within corporate mission statements or core values normally found within high level company publications.

Methodology Case Studies 2 and 3: Validation of Outsourcing Model

through investigation of the outsourcing of fuel filler pipe and fuel delivery model intellectual competency **(high and low specificity commodities**). Both of these commodities are good examples and focal to a fuel system. The fact that they both provide customer interfaces means that they also have the potential to provide influence on resultant warranty data accessible through Ford's Analytical Warranty System (AWS) (Chapter 3.2.4) through fuel filling experiences or fuel level indication respectively.

In addressing these two case studies, the developed outsourcing decision model is used in its intended application. Despite the decision to outsource had already been made the model can still be applied retrospectively to understand the potential outcomes. In its perfect form, the supportive metric/data necessary to address relevant criteria would be supplied directly by people within an organisation that have appropriate expertise and metrics immediately at hand. In both these case studies the Author not only had to learn appropriate systems in order to provide necessary metrics but also had to look at alternative solutions to gathering data.

Methodology Case Study 4: Investigate benefits of introducing a second competitor supplier into a single sourced outsourcing situation

The self explanatory title of this case study provides an extension of Case studies 2 and 3 but concentrates on the quality and costs aspects alone in order to ascertain improvements or detriment in performance.

3.1.4 Discussion, Conclusions and Recommendations for Further Research

Following the case studies, there will be a summary discussion and conclusion of the results of the case studies and their relationship with the developed outsourcing decision model to ascertain its validity and whether or not it needs further development.

3.1.5 Research/Thesis Plan

In order to simplify the understanding of the methodology, a plan of the research associated with the Thesis is shown below (Figure 3.1) depicting the elements described.

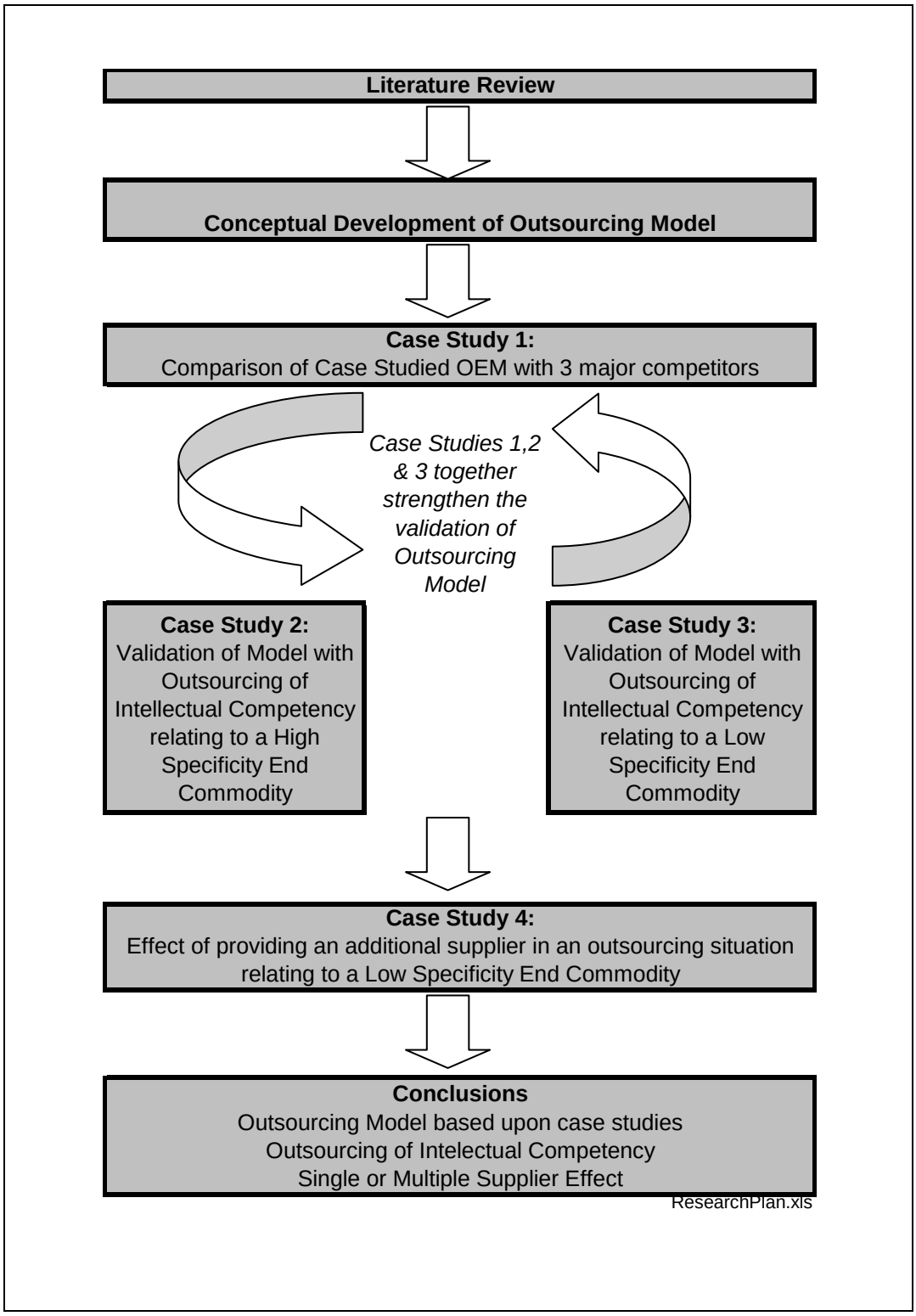

Figure 3.1: Research and Thesis Plan based upon Methodology

3.2 Methodologies within Research Process

The following provides an analysis of the potential and actually employed methodologies within the research. Method of application and associated literature review are included where relevant.

3.2.1 Benchmarking

Benchmarking has long been established as a means evaluating competitive performance (Watson, 1992., and Chang et al.1995 and Damelio, 1995). The application of this process in order to ascertain gaps in competitive performance identifies it as very relevant within the realms of outsourcing in that both are applied with the ultimate aim to increase performance. Benchmarking provides the tool that establishes performance shortfalls whilst outsourcing provides a potential means of increasing subsequent performance. Once an outsourcing decision model has been developed to identify potential performance gains, benchmarking methodology provides the logical process that can be applied to measure derived performance factors before and after an outsourcing initiative in order to ascertain if expected outcomes were met or not.

3.2.2 Questionnaires

The gathering of data in support of benchmarking can be achieved by various methods. Of the five listed by Damelio, 1995, existing data review as exemplified in the body of work covered in Chapter 2 is well known. Similarly,

questionnaires provide another well established method that could be used to ascertain whether or not a supplier has greater expertise.

Literature identifies various methodologies applied to the process of formulating a questionnaire. Within this process it is very important to provide "closed" questions (Dukta, 1993) with potential answers pre-determined by the assessor (Gillham, 2000). The benefits are that they are more meaningful, and easier to answer (Foddy, 1993).

Typical examples of each (Denton, 2005):

Open-ended questions can be either:

- Numeric ("How many hours do you spend at work?")
- Text ("How can the company improve its working conditions?")

Close-ended questions can be either:

- Rating scales (rating a product from excellent through to poor or from 1 to 10)
- Agreement scales (strongly agree to strongly disagree responses to a series of questions)

Scale selection:

With reference to questionnaires and the favourability of closed questions, the question arises on what sort of closed questions. Typically as per the examples given, the most suitable is some form of rating scale. It must be pointed out that a ratings or ranking has a totally different meaning. To ensure this is understood they are both explained by Thomas (2004).

- **Rating:** A measure of frequency, intensity etc.
- **Ranking:** A measure of relative standing.

The importance of this within this Thesis is that although ranking is important i.e. who is best, there is greater worth in understanding how much better A is to B in order to appreciate performance gaps.

Typically there are two types of ratings commonly used the Likert scale (Likert, 1932) and simple linear scales. The Likert scale typically uses five increments but can increase to seven with typical ratings being two extremes e.g. extremely hot to extremely cold. Most questionnaires range typically between 4 and 11 increments with usually the greater number producing most reliable results (Nunnally 1978)

3.2.3 Benchmarking: Method of Application within Research

In order to ascertain whether or not a supplier had greater expertise, the methodology employed was to benchmark both Suppliers and Ford using a questionnaire approach. The process of this benchmarking was carried out in a series of meetings. In the case of new potential suppliers there was a series of familiarisation meetings between various departments to build a degree of corporate familiarisation. This was necessary to provide as close a comparison to "known" suppliers as possible in order to optimise a feel for the knowledge and mindsets of individuals to be used later in assessing whether or not the supplier under review is over or understating their corporate competence. In short, the

familiarisation provided a basis to provide a degree of mutual trust and normalisation of results.

In addition and contributing to these meetings there were visits to manufacturing plants and development centres by Purchasing and Engineering representatives from the OEM in order to further enhance base knowledge of the supplier.

Prior to conducting the surveys, all suppliers were provided with an electronic copy of the assessment rating format and given instructions on how to fill the form in with a specified scheduled date for completion. The completion date was also established as a date where once again the OEM assessors (Purchasing & Engineering) would further visit the respective supplier's development office to review the self-assessment inputs and agree areas where moderation may be necessary. This moderation at supplier development centre was seen as the ideal venue due to the possibility to immediately review areas of disagreement with aid of real evidence. In retrospect this may be observed as being over critical of suppliers and perhaps even being distrustful but in reality it was beneficial to the suppliers in that it provided a consistent approach and level of rating that in some cases boosted a suppliers self assessment rating.

An additional dispensation that was offered to the suppliers in view of their individual historical product knowledge base was that if they could provide reasonable evidence of close co-operation with their Tier Two suppliers they could be justified in including the co-opted enhancement in competence within the assessment. In contrast to this, the surveyed supplier may also claim that they globally have expertise in a given field but within the assessment given a poor competency rating. Each case must be taken on its own merit but for a high competency level to be entered (and agreed) on the survey sheet the supplier

must indicate that the expertise is available on a regular work basis within the European arena and able to sufficiently support a programme. Whatever the level of expertise, if an individual is only available in the USA for infrequent communications on a European programme and unable to devote quality time to a designated programme the rating must be suitably lowered. This was specifically the case of one of the suppliers whereby much of the company's core business is focussed in the USA with minimal business or expertise in Europe. Similarly to using Kepner-Tregoe analysis in the development process of the outsourcing decision model, the analysis was also used to provide a ranking of the relative importance of the criteria within the overall benchmarking.

3.2.4 Analytical Warranty System (AWS)

In order to establish suitable quality metrics, the Ford Motor Company's Analytical Warranty System was employed to extract Repairs/1000. AWS is a computer based system that enables dealers to enter details of customer warranty claims directly onto a computer system. It allows users to access data and statistics of dealer claims based upon searches including specific vehicles, production dates, customer concern codes and many other options dependent upon specific investigations. Repairs/1000 provides a metric which is simply a statistical count of dealer repairs per 1000 vehicles produced.

3.2.5 Kepner-Tregoe Analysis

Both Kepner Tregoe Analysis and the Analytical Hierarchy Process (AHP) designed by Saaty (1980) were considered for prioritising criteria included within the developed outsourcing decision model.

AHP did have some potential advantages in its suitability for aiding the resolution of complex decisions in elements that are difficult to quantify (University of Cambridge, 2007). This advantage is clearly exemplified in that under normal circumstances it may be difficult to compare something related to quality directly with costs. The process makes comparisons of all elements at one pair at a time ranking dependent upon importance of relationship on scales between 1 & 9 and 1/9 to 1. The process does however have some disadvantages in that results may be inaccurate due to or in arbitrary rankings (University of Cambridge, 2007)

The Kepner-Tregoe analysis also uses compared data pairs in its analysis and effectively can be used similarly to provide hierarchical metrics. The essence of Kepner-Tregoe is that each parameter is directly compared with all others and awarded a score of 0, 1 or 2 correspondingly dependent upon whether or not the column parameter is of lesser, equal or more importance. The totals scores for each parameter are then compared to establish a relative ranking, the highest total score denoting the higher ranking. The technique is very simple, easy to scrutinise and can be used to simplify very complex situations.

Due to it's simplicity of application, Kepner-Tregoe Analysis was selected as the appropriate process to be used within this research.

In order to ensure the result of analysis were not biased, where possible the ratings were conducted by groups of individuals to cover an array of opinions. This was applied to all cases with the support of available experts in the field of that being analysed. Team composition ranged between three and four individuals including the Author.

Chapter 4: OUTSOURCING DECISION MODEL

Chapter 4 will provide the basis for development of the outsourcing decision model that aims to be used as a working tool by potential outsourcers in order for them to make the right decision prior to outsourcing. The model should also be self explanatory in that no further research other than specific case data gathering should be necessary to follow the process within the model. The discussion for this will fall into four main categories

1. The construction of a conceptual model
2. Finalisation of model by addition of detailed criteria relating to the elements within the conceptual model
3. Relationship between the Outsourcing Decision Model and Corporate Strategy
4. Application of the Outsourcing Decision Model

Following the development of the outsourcing decision model a validation plan will be constructed based upon those already identified in Chapter 2.12.

4.1 The Construction of a Conceptual Outsourcing Decision Model

The layout of the conceptual outsourcing model will follow a pattern of steps based upon the research within this thesis. The categories for the three steps will be the following;

- Step 1: Investigate
- Step 2: Action
- Step 3: Confirm Results

4.1.1 Step 1: Investigate

The first and most logical step would be based upon investigating if there is any advantage in the company in outsourcing a product or service. In order to provide the answers to this, Step 1 will covered by the series of questions as described in Chapter 2.3 to 2.8 based upon Kipling's **What, Why, When. How, Where and Who,** Although the questions will be used as a basis for the model, their final order and inclusion will be decided upon their individual merits and relevance.

1. **What** to outsource is a key factor and must be answered first. Finding non core competency within an organisation is the key to outsourcing. If none are available then research suggests that the organisation should not consider outsourcing. Since core competency are related to the strategy of a company the question of establishing those competency that are non-core should be a relatively simple task and therefore the first question to be answered.

   "What" provides a clear question that if answered clearly provides the basis of a decision whether or not to proceed further. If the product or service clearly meets the core criteria then there is clearly no need to proceed any further with the process.

Summarising the above;

If the **What** to outsource is determined to be ***Core*** then the potential outsourcer should **Maintain Current Status** and the process should be halted. If it is ***Non-Core*** then the process should continue by looking at the reasons **Why** to outsource.

2. **Why** outsource as discussed in Chapter 2.4 is the next key factor that must be understood early in the process. An organisation must have the knowledge of what the expected benefits are and therefore understanding of it own performance in order to ascertain later if it has achieved a significant advantage through outsourcing. This latter comment also suggest that "Why" should be addressed twice i.e. early in the process to set targets and at the end to understand if benefits have been achieved or not

   If in providing the answers to **Why** no potential benefits were identified (***Zero or Negative***) then there would be no point in progressing further and the potential outsourcer should **Maintain Current Status**. If on the other hand there were ***Positive*** benefits to be gained the potential outsourcer should continue by looking at **When** to outsource.

3. **When** to outsource: Research suggests there are optimum times to consider outsourcing (Chapter 2.5) and therefore it is advisable that this is understood before a decision to outsource is made. If any of the criteria for **When** to outsource are ***met*** the potential outsourcer should proceed

and **Outsource** the product or service. However; if none of the When criteria can be met **(*Criteria not met*)** again the outsourcer should **Maintain Current Status** and the process within the model should be halted.

4. **How:** This criteria is implicit within the model i.e. the steps within the process will effectively provide guidance in how to outsource.

5. **Where** to outsource (Chapter 2.7): The advantages of buying from one of three global regions described by Dobler et al. (1990) are included within the "what to outsource". By defining companies that possess "greater external expertise", a key element associated with "what to outsource" (Quinn, 2000), the important elemental criteria within "where to outsource" are already covered.

6. **Who** (Chapter 2.8): Whilst providing important criteria within the process, they are already included within the defining of non core competency ("what to outsource"). In order to define a non-core competence a factor that must be considered is that there must be in existence a supplier (who) who has superior competence. The "who to outsource to" is therefore based upon this question of superior competence and adequately covered within the question "What to outsource".

Concluding from the discussion regarding the six questions above, Step 1 should include the questions **What, Why** and **When** in the given order. At the conclusion of any of the three questions within Step 1, when answered in the given order, if the criteria within are not met there would be no point in progressing further.

4.1.2 Step 2: Action (outsource the product or service)

If each question, "What" and "When" identify some criteria that are met and potential benefits are identified in "Why" it would follow that the next logical step would be to outsource.

Step 2, Action would be based upon an understanding of the benefits and criteria gathered within Step 1.

4.1.3 Step 3: Verify results

Following a suitable period of outsourcing it would be logical and sensible to check that the benefits achieved have been realised. Additionally, it would be equally as important to ensure that in attaining set goals that other aspects of business performance have not been weakened by the outsourcing strategy. This is very important, if outsourcing has not been successful in improving performance the outsourcer should understand why in order to remedy. This point is reflected within the "When to outsource" criteria. The point "When risk intensity is low" identify that there should be a sound fall back plan with a possibility to reverse the initiative. Obviously it is not mandatory that an

outsourcer should adhere to this criterion, however a situation whereby outsourcing has not provided the expected advantages or indeed caused related negative benefits clearly highlights the importance of this it.

Within Step 3 the logical approach would be to recheck the expected benefits based upon the metrics derived in the "Why outsource" question in Step 1. In addition it would be worth a further review of other related metrics within the organisation to ensure no other detriment to business performance has developed through outsourcing.

In the assumption that things have deteriorated or that performance targets have not been achieved it would also worthwhile re-examining the other two questions in Step 1, What to outsource and When to Outsource. It may be that either the answers were incorrect or perhaps the ensuing time has changed them.

4.1.4 Conceptual outsourcing decision model

The discussion relating to steps 1 to 3 is fully illustrated in Figure 4.1.

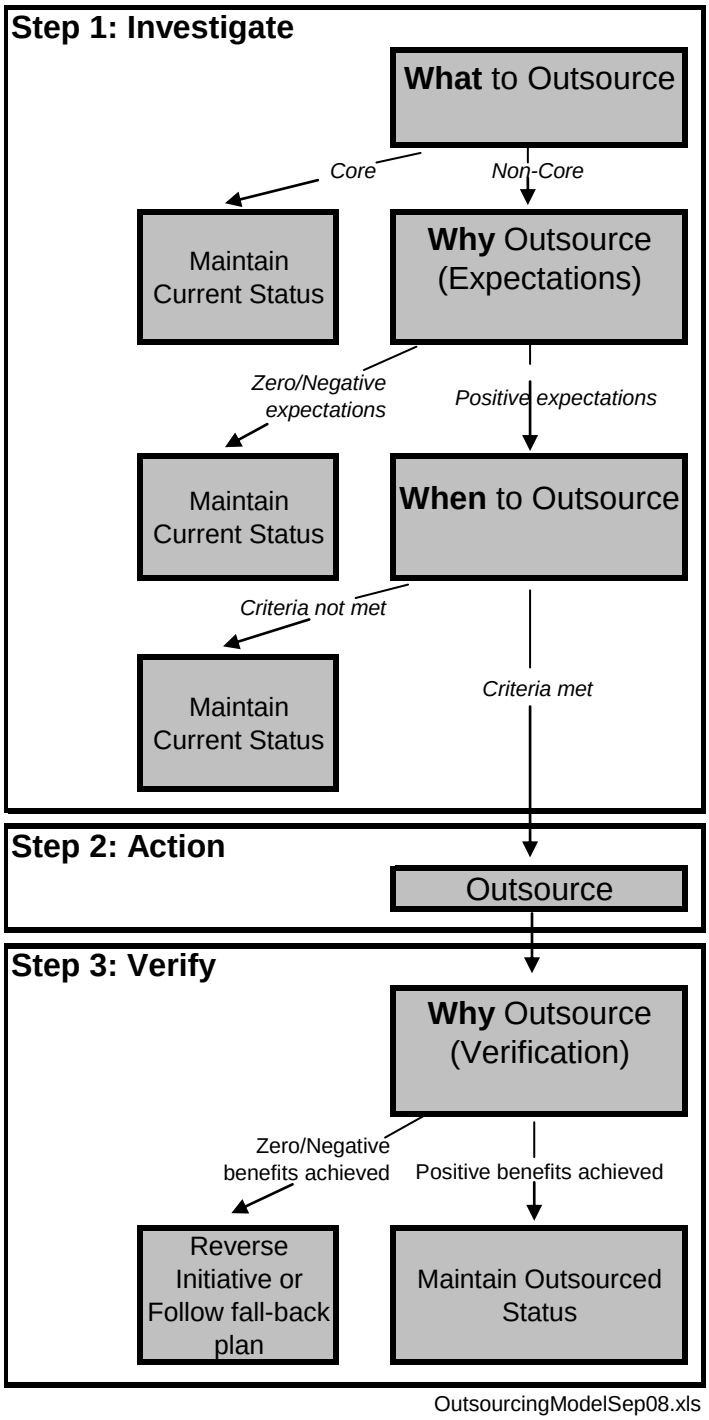

Figure 4.1: Conceptual Outsourcing Decision Model

4.2 Analysis of Criteria Within Outsourcing Decision Model

Following the development of a conceptual outsourcing decision model, the following discussion will be aimed to finalise the model by providing the potential outsourcer with the relevant guidance in order to make the model a stand alone tool. Other than the data necessary to support a particular application of the model it should provide the potential with all the necessary guidance and direction to make the correct decision to outsource or not. The following discussion will therefore be based upon the addition of detailed criteria relating to the elements within it. The discussion will endeavour to provide not only detailed criteria but potential metrics in order to provide greater clarity to the decision process and will address each of the four major steps in turn. The major steps reviewed will be covered by What, Why and When as identified in Steps 1 and 3 as applicable. Whilst "Why" is seen within the conceptual decision in both Steps 1 and 3 its content does not change in each, its only difference being within its application between the Investigation and the Confirmation steps.

4.2.1 Step 1, Investigate: What to outsource

In order to establish some order of hierarchy to the finalised out-sourcing model the key criteria gathered through research in Chapter 2 was necessary to apply some form of methodology. The most suitable methodology identified was Kepner-Tregoe analysis (Chapter 3.2.5) as this provided the simplest and most effective way of analysing the hierarchical order.

In order to carry this out, each criteria was in turn compared to the other criteria and awarded a score of 2 if greater importance, 1 if equal importance and 0 if lesser importance. The accumulated results could then be added to give a total for each criterion. The final results for each criterion would then provide the basis for the hierarchy.

Table 4.1 illustrates the results of this analysis. The resultant totals shown in the second from last column, Greater external expertise (5), Expertise non-strategic (3), Low specificity (1) provide a final ranking identified in final column. It can be observed that if there is externally greater expertise then an organisation should not look upon a competence as strategic irrespective as to whether an activity or capability asset specificity is high or low. The final ranking therefore appears valid.

Table 4.1: Kepner-Tregoe Analysis of What to Outsource, Detailed Criteria.

	Low specificity	Greater external expertise	Expertise non-strategic	**Totals**	**Resultant Ranking**
Low specificity	1	0	0	1	**3**
Greater external expertise	2	1	2	5	**1**
Expertise non-strategic	2	0	1	3	**2**
Memo: 2=greater importance, 1=equal importance, 0=lesser importance					
ModelRankingKepnerTregoe1.xls					

The three criteria will now be summarised based upon the research carried out in Chapter 2.3 following the revised priority in order to concentrate on greater detail and suitable metrics.

Greater external expertise can be measured through an examination of relevant patent activity as per research through Pakes et al. (1984) with the proviso that comparisons are only made between similar global regions. Additionally Research and Development Budget may be indicative of expertise (Parasuramen et al. 1993; Franko, 1989; Morbey, 1989) but is unreliable when comparing organisations of different sizes. By far the best way of obtaining metrics would be through benchmarking as discussed in Chapters 3.2.2 and 3.2.3. This is a well proven process that can be used to measure any required dimension within a company. Although Benchmarking would provide the greatest clarity, its disadvantage is the high cost to implement.

Expertise non-strategic in a perfect world would be identified within a company defined company strategy and therefore would be the first thing to look at. However, in the case where an outsourcing strategy is being instigated by the same management that develop the strategy one must logically assume that the expertise associated with the outsourced entity is non-strategic.

In the absence of a clear and coherent strategy, if relevant, a reduction in associated Research and Engineering budget may indicate that expertise is non-strategic in a given organisation. (Lynch, 1997).

Additional ways of determining a corporate strategy may be through other corporate statements e.g. Core Values or Mission Statements.

Low Specificity: Table 4.2, put together to illustrate the key characteristics of high and low specificity provides a clear picture of each. Because Low specificity is the object of outsourcing, the identifying characteristics have been reviewed in order to provide potential metrics. The detailed drivers, identifiers and metrics associated with Low specificity and the other drivers for "What to outsource" is shown in Table 4.2. This table represents the full detailed content of "What to outsource" in the conceptual outsourcing decision model Figure 4.1.

Table 4.2: What to Outsource, Detailed Identifiers and Potential Metrics

What to Outsource		
Non-Core Competency Drivers	Identified by:	Examples of Potential Metrics:
Greater external expertise	Suppliers have special skills or knowledge, greater innovation	# Benchmarking rankings # Quantity of Patents (If in similar global region)
Expertise non-strategic	# Company strategy # Company strategy implied by management # Core values # Mission statements	# Relative Research and Development budget
Low specificity	# Low costs to utilise entity for other purposes # Many potential customers for entity # Low data transfer needed to implement and run	# Costs # Size of Market # Quantity of unique specifications, drawings etc

4.2.2 Step 1, Investigate and step 3, Verify: Why outsource

The detail for the "Why Outsource" criteria within the conceptual outsourcing model will use the prioritised list from a survey provided by Elmuti et al. (2000) as the basis for construction.

Costs: Clearly and logically lower costs are a leading driver for outsourcing including both direct and indirect costs defined and broken down by Dury et al. (2001). From Dury's point that costs may invariably change over a given time it is important to gain knowledge of costs ideally over a protracted period, i.e. a given product/service cycle in order to provide an accurate assessment.

Quality: Researched **o**pinion is clear in that quality must be aimed at the end customer and therefore representative metrics must be used to reflect this. The selection of potential metrics provided is not necessarily complete as many organisations may have unique customer requirements. Despite this the list provides indicative measurements so that an organisation can develop its own potentially unique metrics importantly focussed on the end customer.

Technology: Relating to "What" and "Greater external expertise", outsourcing can provide access to new and improved technology (Simchi-Levi et al. 2000). It is therefore appropriate that similar metrics can be used i.e. does the supplier have access to advantageous patents and licences.

Delivery and Reliability: As observed by Ruffa et al. (2000), late deliveries and poor quality are known to drive up a company's inventory, cycle time and schedule variations. From this point of view it must be apparent that corresponding data from the supplier should provide necessary input to aid an outsourcing decision.

Gain Resources: The literature reviewed points to a list of potential resources to be gained in an outsourcing situation i.e. Technical. Brand, People & Organisation and Capital (Azzone et al. 1995) with the addition of Strategic by Macpherson (2001). The outsourcing model uses examples of metrics provided through research for each of the resource elements.

Table 4.3 provides the detailed summary of the "Why outsource" within Step 1: Investigate of the conceptual outsourcing decision model identified by Figure 4.1. Also included are additional but lesser reasons for outsourcing based upon elements provided by Elmuti et al. (2000) from Appendix 5.

It must be emphasised that the "Why outsource" part of Step 1 within the decision process would logically be followed twice, firstly prior to embarking on outsourcing and secondly, after a period of outsourcing to ascertain if the initiative provided the expected (or none expected) advantages within Step 3 (Confirm).

Table 4.3: Why Outsource, Detailed Identifiers and Potential metrics

Why:	**Identified by:**	**Examples of Potential Metrics:**
Costs	Direct and Indirect costs determined over a period of time Direct: those that can be directly associated Indirect: those that are shared e.g. line supervisor	Direct Material/Labour, Prime Costs (Sum of Direct Costs), Indirect Materials/Labour, Total Manufacturing Costs (sum of Direct and Indirect Costs)
Quality	Must be relative to end customer's perceived expectations of outsourced entity or its end product. Metrics are highly dependent on outsourced entity Could include brand name and reputation	Repairs/1000, Things Gone Wrong (TGW), Things Gone Right, Consumer Reports, Calls/hour e.g. service call centre
Technology	When technology is rapidly changing. Supplier has superior technology either in products or processes	Patents, Licences
Delivery and Reliability	Efficient and responsive delivery	Lead times, Inventory levels, Schedule variations
Resources	Technological Brand Capital People & Organisation: Functional Operational Strategic	Patents, processes, registered designs Customer awareness ratings, Customer retention rates Company Assets Quantity of skilled people, Employee efficiency, staff turnover, hire costs, grievances Revenue per employee Recruiting costs relative ROI, Benefits packages, Diversity programmes Demographics, Current versus future needs
Materials	Unique Material/Product availability	Specialist Materials/Products
Presence in a foreign market	Improved access to market, Improved local advertising/acceptance, Relaxation of import barriers	Import tariffs, Market penetration data (sales, turnover)
Market flexibility	Less bureaucracy, overheads, capital expenditure to move faster	
Skills/Knowledge rationalisation	Reduced resources and related administration	Lower headcount, Lower data administration
Capital funding re-allocation	Greater liquid assets	
Competitive position	Improvements in company advantage	Superior inflation rates, Located to access emerging markets, Lower import tariffs, Reduced trade balance obstacles, Improved sales
		Why Metrics.xls

4.2.3 Step 1, Investigate: When to outsource

Quinn (2000) provided the basis for the "When" criteria within the outsourcing model. In Chapter 2.5 his list originally comprising of seven drivers was reduced to five and using the same process as the criteria associated with "What to Outsource" the criteria will be prioritised through Kepner-Tregoe Analysis.

The analysis and final order is presented again in Table 4.4 with the individual rankings identified in the last column.

Table 4.4: Kepner-Tregoe Analysis to Prioritise "When to Outsource" Criteria

	Risk Intensity is low	Volatility high	Fast moving technology	High internal costs	Chance of strategic block	**Totals**	**Resultant Ranking**
Risk Intensity is low	1	2	2	2	2	9	**1**
Volatility high	0	1	1	0	0	2	**5**
Fast moving technology	0	1	1	0	2	4	**3**
High internal costs	0	2	2	1	2	7	**2**
Chance of strategic block	0	2	0	0	1	3	**4**
Memo: 2=greater importance, 1=equal importance, 0=lesser importance							
ModelRankingKepnerTregoe2.xls							

The detail associated with the "drivers" as described by Quinn (2000) is discussed in Chapter 2.5 and summarised in Table 4.5. Metrics have been added where relevant.

Table 4.5: When to Outsource, Detailed Identifiers

When to Outsource		
Timing:	**Identified by:**	**Metrics**
When risk intensity is low	Possibility to outsource in steps Possibility to reverse the initiative A sound fall-back plan	
When internal transaction costs are high	Higher costs in comparison with competitors/suppliers	Labour Costs Tooling Cost Overheads
When technology is moving too rapidly	Rapid change of product/service technology Associated changes are rapidly increasing in cost and complexity	Patents
When there is a chance of a strategic block	An opportunity to isolate key control items: i.e. customer contact with resultant feedback, key technology or knowledge	
When volatility is high	Emergence of global competition New technology Public Policy: e.g. Government deregulation, privatisation Market uncertainty Escalating labour issues	

The detailed criteria established now become part of the completed outsourcing decision model. The detailed criteria for When to outsource, Table 4.5 now joins Tables 4.2 and 4.3 to become an integral part of the outsourcing decision model depicted in Figure 4.2

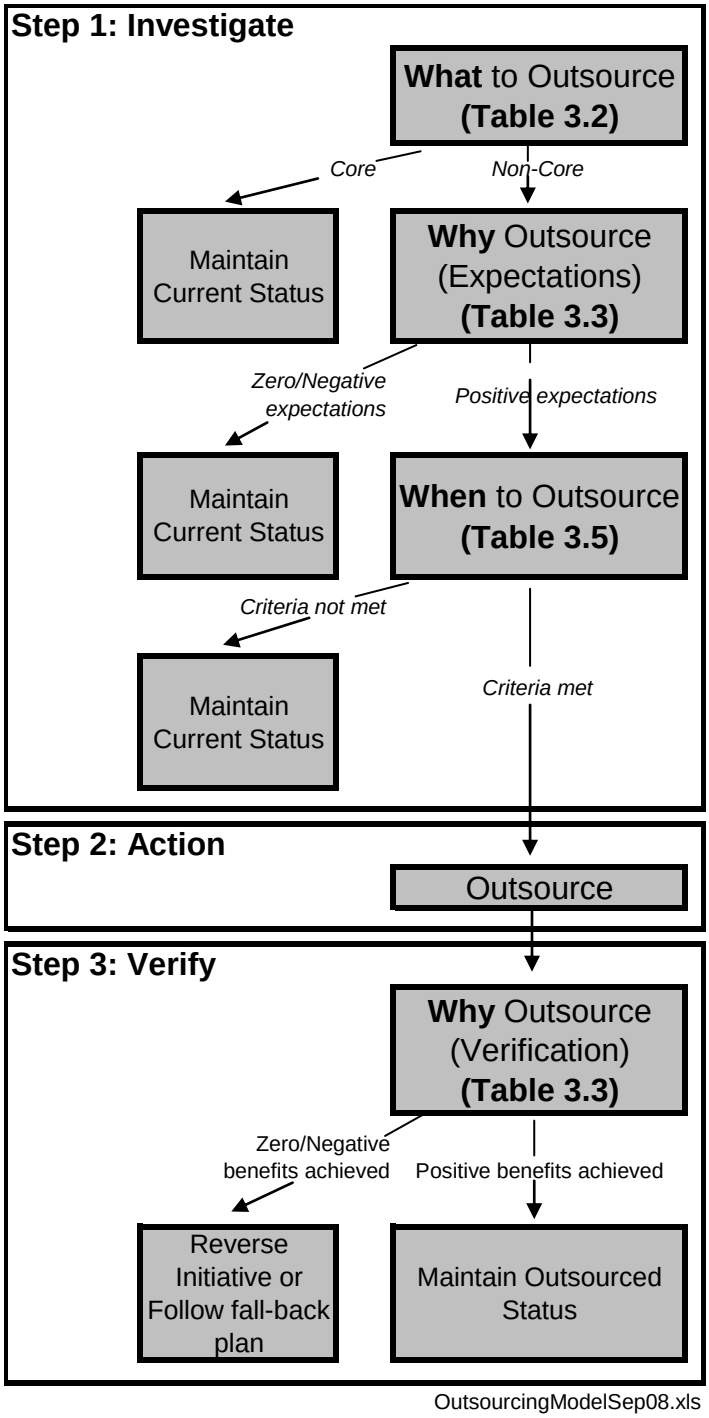

Figure 4.2 Outsourcing Decision Model including references to relevant detailed tables

4.3 Relationship Between the Outsourcing Decision Model and Corporate Strategy

In Chapter 2.1 an initial review was made of corporate strategy and its drivers, however at that point the subject of outsourcing had not been discussed and the relationship between corporate strategy and outsourcing had not been covered. The outsourcing model developed represents a summary of the research and subsequent discussion which now enables the best opportunity to review together with the fundamentals of corporate strategy in order to understand if there are any particular strategic drivers associated with an outsourcing strategy.

Table 4.6, illustrates a summarised review of how the key categories defined in

Table 4.6: Relationship between Outsourcing and Corporate Strategic Drivers

Relationship between Outsourcing and Corporate Strategic Influences						
Detailed Criteria Within Outsourcing Model	Strategic Influences					
	Global Environment	Industry Environment	Industry Life Cycle			
			Introduction	Growth	Maturity	Decline
Low Specificity		X	X	X	X	X
Greater external expertise		X	X	X	X	X
Expertise non-strategic		X	X	X	X	X
Risk intensity is low		X	X	X	X	X
Volatility is high	X	X			X	X
Fast moving technology	X	X	X	X	X	X
High internal costs		X	X	X	X	X
Chance of strategic block		X	X	X	X	X
Improved Quality		X	X	X	X	X
Reduced costs		X	X	X	X	X
Improved Efficiency		X	X	X	X	X
Improved Competence		X	X	X	X	X
Improved exposure to worldwide environment		X	X	X	X	X
Reduced resources		X	X	X	X	X

Strategy-Drivers.xls

the outsourcing decision model developed aligns with corporate strategic influences. The following discussion will address each of the two environments and industry life cycle in turn.

4.3.1 Global environment

One can see that the Global Environment, whilst massive in its potential is one of the lesser drivers for an out-sourcing strategy. Ansoff et al. (1990) identified that volatility closely aligns with a high turbulence level as illustrated on the Assessment of Dynamics of the Environment (Appendix 1) Obviously this volatility could be directly linked to an industry level environment; however, a major economical or political shift could have similar impact. Again fast moving technology may provide a high turbulence for example major new technological developments that may occur through wartime conflict.

Whilst improved exposure to worldwide environment may appear to be a candidate for inclusion within the global environment, it is excluded however as the global environment in question is industry level related.

4.3.2 Industry environment

Clearly the Industrial Environment is included as relevant in all categories listed within Table 4.6.

Table 4.7 identifies a further analysis comparing Porter's Five Forces with the categories identified within the outsourcing model. The categories have been simplified in order to show subject headings more clearly.

The analysis proved to be more complex than expected. The initial assumption was that there would be a random broad scatter of crosses that identify an outsourcing model category to each of Porter's forces; however a deep analysis proved otherwise. Each of Porter's five forces can be reflected in any one of the categories listed. It may not be that each is directly related, particularly at face value, however each category has implications that can continue to the extreme of analysis to be affected by all of Porter's forces. This is the case based upon generic principles with no particular organisation being used as a case study. It would be expected that a further analysis based upon a particular organisation with particularly defined boundaries on each category would provide a more random result.

For the purposes of the Thesis, the analysis of Porter's Five Forces does identify a close linkage between outsourcing as a strategy to the Industry Environment.

Table 4.7: Relationship Between Detailed Criteria of Outsourcing Decision Model and Porter's Five Forces

Detailed Criteria Within Outsourcing Decision Model	Porter's Five Forces				
	Threat of New entrants	Bargaining power of suppliers	Bargaining power of *customers*	Threat of substitute products or	Rivalry among existing firms
Specificity	X	X	X	X	X
Expertise	X	X	X	X	X
Supplier margins	X	X	X	X	X
Volatility in Industry	X	X	X	X	X
Pace of technology	X	X	X	X	X
Internal costs	X	X	X	X	X
Potential strategic block	X	X	X	X	X
Quality	X	X	X	X	X
Costs	X	X	X	X	X
Efficiency	X	X	X	X	X
Competence	X	X	X	X	X
Exposure to worldwide environment	X	X	X	X	X
Resource level	X	X	X	X	X
Strategy-Porter.xls					

4.3.3 Effect of industry life cycle

Chapter 2.1.2 identified that there is no clear linkage between an outsourcing strategy and a particular phase in the industry's life cycle. Despite this, it was also clearly evident that there was a gradual increase in significance on the categories identified between the Introduction and Decline phases of the Industry Life Cycle.

The category of "Volatility is high" provided an exception with the view that it would be very unlikely that high a highly volatile environment at Industry level would be present in an Introduction/Growth phase.

In all case though, a trend is shown that an outsourcing strategy is more likely to occur in the latter phases of the life cycle. For example (Lynch, 1997) in (Appendix 2) identified that at the Introduction Phase, customers will accept some unreliability and by the Growth phase both reliability and quality improvements are necessary. By the Maturity Phase, competition is based largely on Quality whereas by Decline, when Quality is firmly established as a qualifier, cost control becomes a priority. With this in mind it can be seen that with quality levels rising all the time the effect of outsourcing has greater impact and would therefore more likely take place during the latter phases.

From the previous discussion it can be seen that whilst all key criteria within the outsourcing model are clearly influenced by the industry level environment, only two are influenced by the global. Whilst the global environment can ultimately influence the industrial environment the major factors necessary to be determined within an outsourcing decision are based upon those influenced by the industry level environment.

4.4 Application of the Outsourcing Decision Model

The model proposed in this work has been clearly identified and described in this Chapter already. Within the descriptions there are some notes that go to some way in describing its application to real scenarios. For clarity the following will provide the detail of how the model would be applied.

The first and most important point is that the model will always be based upon a product or service that the user expects to outsource and that this is the focus of all criteria, decisions or metrics within the process of using the model.

Once the entity to be outsourced has been identified the user can apply it to the model. Following the steps one at a time, in the given order, the operator would begin the process through Steps 1 to Step 3 as identified in Figure 4.1.

Step 1: What to Outsource (See Table 4.2)

The three criteria identified are potential indicators of whether a potential outsourced entity is either core (should be retained in-house) or non-core (should be considered for outsourcing). Ideally, all three criteria would be either positive or negative in any given situation, identified by comparing given metrics, but in reality it may be that only one indicates a given direction. The important point here is that at least one of criteria must be positive with the remaining two being neutral before an entity can be considered non-core and potentially suitable for outsourcing. For example, it would be foolish to outsource an entity where expertise is non strategic when the only potential suppliers have inferior expertise. If the potential outsourced entity is determined as Core then the

decision process is effectively halted and the entity should remain in-house as indicated by the "Maintain Current Status" field on the outsourcing decision model. If the indication is that the entity is non-core the decision process can be followed further by moving on to the next field within Step 1.

Step 1: Why Outsource (Expectations) – (See Table 4.3)

Within this field, there are many potential expected advantages that may be expected through outsourcing. Each organisation will have different expectations of what is to be gained. Whilst this is an important focus it is also necessary to consider what advantages also are potentially lost. For example, the model indicates that improved quality is a potential outcome; however this may be at the expense of greater cost. Whilst this is not necessarily a corresponding outcome, it is possible and so it would be up to any organisation to determine its own expectations and select criteria that match them but also focussing on criteria that may logically be at risk. Some risks may be acceptable to an outsourcer and would not necessarily justify a halt to outsourcing. It would be up to the outsourcer to decide whether a trade-off between potential advantages and risks is acceptable or not. The importance of the metrics at this point may appear time consuming and non-productive. However, it does provide a focus on the opportunities and risks that can be further verified once outsourcing has been implemented.

With this in mind, any user would need to customise their own expected outcomes to develop metrics for measuring performance before or after

outsourcing. The model provides a list of the more likely expected outcomes with associated detailed criteria potential metrics where applicable for guidance. At the completion of this part of Step 1, the potential outsourcer will have selected and evaluated the potential risks and advantages of outsourcing, analysed current and potential future status through suitable metrics and decided that the expectations are zero, negative or positive. A zero or negative expectation of benefits would suggest that the entity should remain in-house and therefore that there would be no further action required in the outsourcing decision. The path within the outsourcing decision model would therefore lead to the "Maintain Current Status" field.

Alternatively if the perceived benefits do appear positive the operator would then progress to the field "When to Outsource"

Step 1: When to Outsource (See Table 4.5)

The elements within this field are not necessary mandatory in being co-ordinated within the outsourcing progress but they could potentially increase the likelihood of success. There is though one exception that the operator should consider carefully, both in general within this field or even if all other "When" criteria are met. The advantage of outsourcing when risk intensity is low cannot be over estimated. The purpose of the decision model indicating "Why to Outsource" in two separate steps both before and after outsourcing provides a clue that success may not be guaranteed. The opportunity to minimise risk by outsourcing when risk intensity is low by either outsourcing in steps, planning a possibility to reverse the initiative or having a sound fall-back plan appear to make good

business sense. Without meeting any of the criteria the operator is free to continue to Step 2 and Outsource the entity but it would be advisable to re-consider and at least incorporate one of the sub-criteria within the field "When risk intensity is low".

Step 2: Outsource

Please refer to Chapter 4.1.2

Step 3: Why Outsource (Verification) – (See Table 4.3)

After a suitable period of time of outsourcing based upon a full cycle of business activity, the outsourcer should check the status of the expectations and accepted risks to see if they have been achieved. At this time also, a review of the potential risks should also be carried out in order to either make adjustments or reverse the outsourcing process. It is at this point that the importance of the metrics gathered before outsourcing is shown by comparing with the corresponding data after.

Assuming the verified metrics are positive or acceptable to the outsourcing organisation, the outsourcing can deemed to be successful; however it would be a wise practice to continue monitoring performance. If contingency measures were taken in the outsourcing organisation to mitigate any risks of outsourcing then this would be a good opportunity to review them.

Alternatively if the metrics indicate an unacceptably worsened situation the outsourcer may wish to reverse the initiative or resort to a fall-back plan to improve the situation as identified in the model.

4.5 Metrics applied to Outsourcing Model and Method of Analysis

The objective of the metrics is to understand the current situation both before outsourcing and after outsourcing. This difference is the sum measurement of the success or failure of the outsourcing decision. With this in mind, the former situation (before outsourcing) would provide the basic array of metrics which should be equated to zero with any change to this as a result of outsourcing being an incremental change. This change obviously could be positive or negative. Due to the fact that various metrics are used and to provide the incremental changes in comparable data, it is proposed that resultant changes in performance are equated to percentages, the post outsourcing data being percentile increments, positive or negative relative to the pre-outsourcing data which was equated to a zero base-line.

In the event that any metric value exceeds +/-100%, within the model any such value should be capped as 100% in order to maintain a sensible level of meaningful focus. Clearly any outcome of this nature is still important and needs to be considered, however for the decision making approach, the logical maximum of +/-100% is all that would be necessary in supporting a directional decision.

Any performance change that is negative is obviously undesirable and may be potentially unacceptable but obviously there is a potential that counter positive

results make them acceptable. It would clearly be up to the outsourcer to decide whether or not the strategy has been acceptable or not.

In order to clarify the handling of the metrics/conditional criteria the following Table 4.8 provides some simple guidance.

Table 4.8: Method of presenting Metrics or Conditional Criteria for individual items within the Outsourcing Decision Model

		A	B	C
		Comparable Metric	**Conditional Criteria**	**Not Applicable or Neutral**
Pre Outsourcing Status (Base line)	Resultant A1	((A1-A2)/A1) x 100% Better = (+) Worse = (-)	Met = +100%	0%
Outsourced Status *(Potential or Actual)*	Resultant A2		Not Met = -100%	

Metrics.xls

Since all items fall into the category of a directly comparable metric, a conditional criterion, not applicable or neutral they must be handled to be comparable. Therefore the only options to be available for entering into some form of summary display for any case study would be either of the highlighted above in columns A, B and C. Regarding comparable metrics it may be that in some cases a higher resultant A1 compared to A2 may be an advantage whereas in others it may be a penalty. In each case the user would have to decide, entering either a positive or negative symbol as necessary.

Whilst in the final analysis a deficit in a comparable metric, -100% for example may not necessarily be directly equivalent to a positive 100% met criteria they can still be viewed and compared at a later stage.

To aid analysis of resultant data when comparing pre to post outsourcing data the results could be displayed in a bar chart but where there are numerous metrics to analyse further, Kepner-Tregoe analysis provides a solution. The proposed display would be as shown in Figure 4.3.

Figure 4.3 illustrates hypothetical results as an example with added notes to aid decision based upon the detail within Chapter 4.5 i.e. the note clarify the minimum acceptance levels for the “What” and “When” fields. One can see that the resultant criteria are clearly identified enabling the potential outsourcer to make informed decisions and trade-offs if necessary.

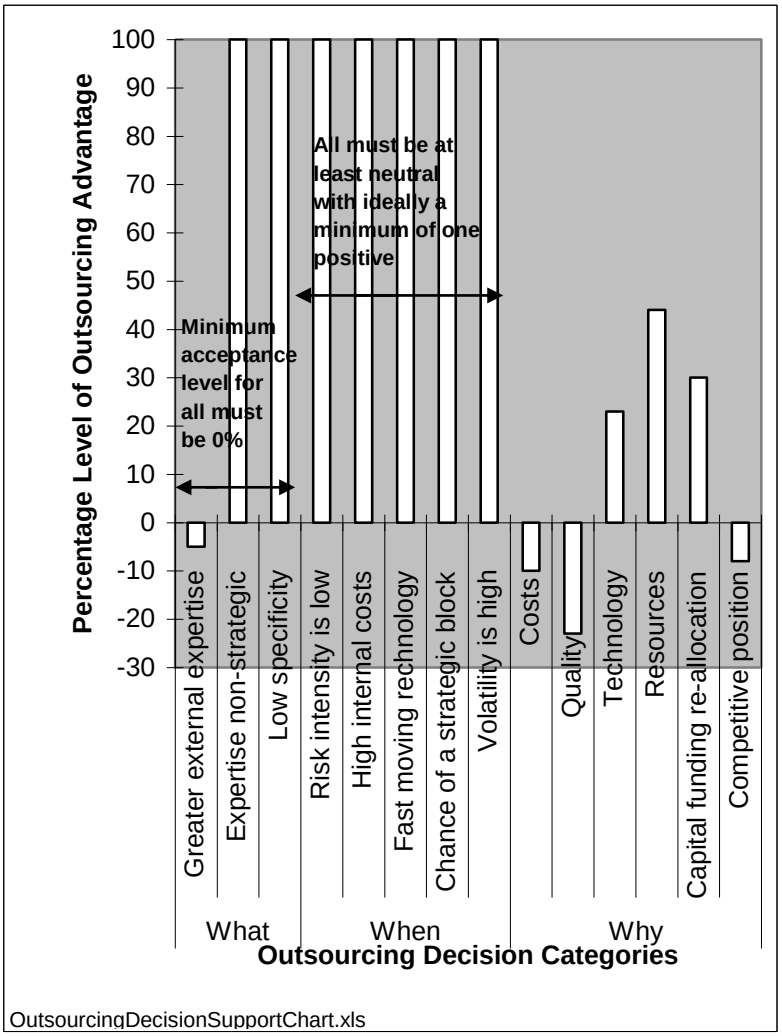

Figure 4.3 Suggested method of displaying data gathered whilst using the Outsourcing Decision Model

4.6 Outsourcing Model Validation Plan

Chapters 3.1.2 and 3.1.3 covered the theory behind case studies and the background to the case study philosophy used within this research. Chapter 4.6 covers the application related detail to these case studies.

Maintaining an overview of efficiency relating to the use of case study research, the aim of any validation plan was to meet two key objectives:

1. To validate the outsourcing model.
2. To provide evidence that could be fed back into improving the application or accuracy of the model.

Clearly, any other resultant evidence provided within validation that could enhance the wealth of knowledge on outsourcing or provide useful feedback to the owner of the specific case study would also be of added value to the research. Due to the nature of the model, it was clearly obvious that the use of real case studies would provide the most appropriate validation. From the perspective that the outsourcing model was developed in order to provide a "hands-on" decision making tool, real case studies would enable applicable criteria to be applied to the various elements within the outsourcing model in order to provide a comprehensive fit of purpose.

Many considerations were taken into account when selecting specific case studies to be used within the research. The most important consideration was;

(a) Do the case studies provide a broad and in-depth inter-reaction with the outsourcing model sufficient to provide a comprehensive validation?

In addition to this, other considerations are broadly supportive and include:

(b) Is the data to support the case studies available and sufficiently detailed?

Addressing the first consideration, various potential case studies were considered which included using evidence gathered through literature review. After an initial investigation into the viability of this option it was clear that much evidence did not provide the detailed evidence necessary to apply to the model. Whilst this validation methodology would provide a degree of validation it would be at too high a level and therefore somewhat superficial.

It was clear that in order to provide a comprehensive validation with sufficient depth it was necessary to utilise case studies within the Author's parent organisation. This not only had the benefit of greater freedom in the availability of necessary data and input but also provided totally new evidence on unique cases which at the time of implementation, the outcomes were unknown. The added contrast within this scenario compared to using available data from literature review was that the result was unknown and therefore provided a further element within the real application of the model. In real life no outsourcer would know the outcome before implementation.

The following provides a breakdown of the resultant outsourcing model validation plan:

An indirect validation of the outsourcing model used to triangulate with case studies 2 and 3, case study 1 will be conducted by comparing the relative sourcing activities of the subject outsourcing OEM (Ford) with Toyota, PSA and Volkswagen.

Case Studies 2 and 3 will then follow based upon High and Low Specificity *end products* respectively.

Since all three case studies are based upon outsourcing of intellectual competency by OEMs, the resultant conclusions should strengthen or alternatively identify weaknesses in the model that would need further enhancement.

Case study 4 adopts a different approach and whilst not being used as a total validation case study is added to identify if an outsourcing outcome can be revised in order to enhance performance i.e., if outsourcing has progressed and is not necessarily providing the expected outcomes, should the entity be back-sourced or are there other alternatives? This case study is somewhat prompted by the potential of supplier opportunism (Lonsdale, 1999 and Vining et al. 1999) and using countermeasures of using multiple suppliers (Anderson et al. 2000 and Williamson, 1979). This case study establishes the effect of adding a second supplier in a stable single sourced situation and determines if this is a potential means of enhancing performance.

The following Figure 4.4, based upon the elements of the outsourcing model identifies the elements to be investigated and their respective chapters. Because there would be much duplication of data presentation if each case followed the outsourcing model individually some elements will be investigated jointly in the leading Chapters. These are identified clearly below and will be re-iterated at the points of re-introduction as they occur within the case studies. In all cases, the activity had already been outsourced and therefore the validation plan will reflect this by eliminating the "Why Outsource (Expectations)" portion of the model. As this portion will effectively be reviewed in "Why Outsource (Verification)

within Step 3 this is seen as only a minor deviation from the preferred application of the model.

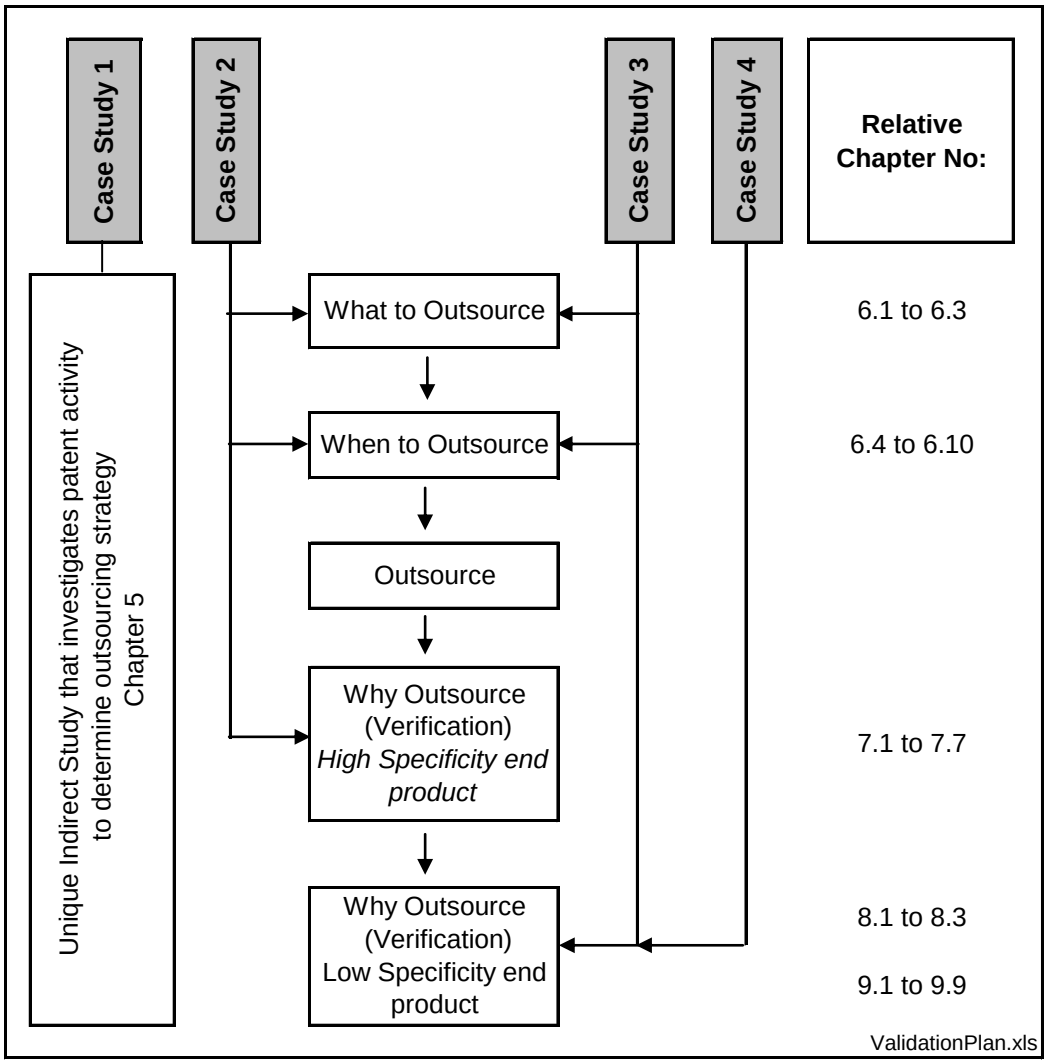

Figure 4.4: Visualised Validation Plan of Outsourcing Decision Model Identifying Chapters Relative to the Specific Elements of Model and Case Studies

4.7 Summary: Chapter 4

Within chapter 4 the generic outsourcing decision model has been developed and based upon research from academic and industry level papers. It has been

evident throughout that whilst industry level opinion particularly that derived from the subject OEM within case studies is real and valid it is already captured by other papers within the research.

The Outsourcing Decision Model generated has been developed so that it can easily be followed at industry expert level i.e. all terms that may be unclear are explained in normal industry level terminology (e.g. Specificity). It also uses well known and established processes. A high level model that requires much reading to understand its application may be useful for academic research purposes but other than this would be of little value on its own. Hence the model has been developed as a simple tool for industrial application to act as a real guide for the people that would execute a real outsourcing situation.

The next Chapters will be involved in validating the derived Outsourcing Decision Model.

Chapter 5: CASE STUDY 1- REVIEW OF FORD MOTOR COMPANY FUEL SYSTEM OUTSOURCING STRATEGY WITH THREE MAJOR COMPETITORS

This first case study provides a logical start in validating the researched outsourcing decision model in that its indirect approach, comparing OEM's activity regarding outsourcing of fuel system intellectual competence, reinforces and triangulates with those subsequent that utilise a direct application to the outsourcing decision model. Additionally it provides a foundation for the reader to understand the background of the industrial environment within the following case studies. It compares Ford Motor Company Ltd, the subject outsourcer with three of its major competitors in its strategic view of the outsourced entity (Fuel System Intellectual Competence). The companies selected for comparison are all major competitors within Europe. Each was selected to provide a broad range of major global OEM's. **Toyota** was selected as the major competitor who within the period of research between 2002 and 2007 (PricewaterhouseCoopers, 2003a, 2007) climbed from fourth to first in the world's production volumes (9.7 million) compared to Ford in third (7.7 million). **Volkswagen**, also a major OEM ranked fifth (5.7 million) with a similar global presence to Ford was selected as a median competitor. **PSA,** ranked eighth (3.4 million), was selected as a smaller competitor.

A review of literature did not disclose the strategic intent regarding outsourcing of fuel systems intellectual property any of the fore-mentioned OEMs. To

understand how the OEMs treated this outsourcing it was necessary to look indirectly through alternative means.

In order to achieve this, a study of patent activity and corporate strategy within the automotive industry was made. This was necessary to understand if Ford Motor Company was alone in their adopted approach of outsourcing of intellectual competence regarding fuel systems. The added benefit from this exercise would also be to provide some indication on the level of expertise within the OEMs and suppliers, the outcome of which would be used to provide further input to the developed outsourcing model.

5.1 Patent Activity within Automotive OEM as an Indicator of Corporate Strategy

Any OEM can determines its individual outsourcing strategies based upon its own strengths and weaknesses, similarly, whilst one facet of outsourcing may be core to one OEM it may be viewed as non-core to another. This part of the thesis covers the investigation of the differing outsourcing policies between four OEMs, all of which in recent years having been identified as leaders in the industry. This investigation compares known outsourcing activities with patent activity based upon the assumption that patents are used to protect company intellectual property which in turn by definition must be based upon a high degree of intellectual competence.

5.2 Global Patent Activity of Four Major OEMS – All Patents

Figure 5.1 indicates the overall Global patent activity of the four OEMs by showing the total patent applications and filings between 1991 and 2005 in the major global markets.

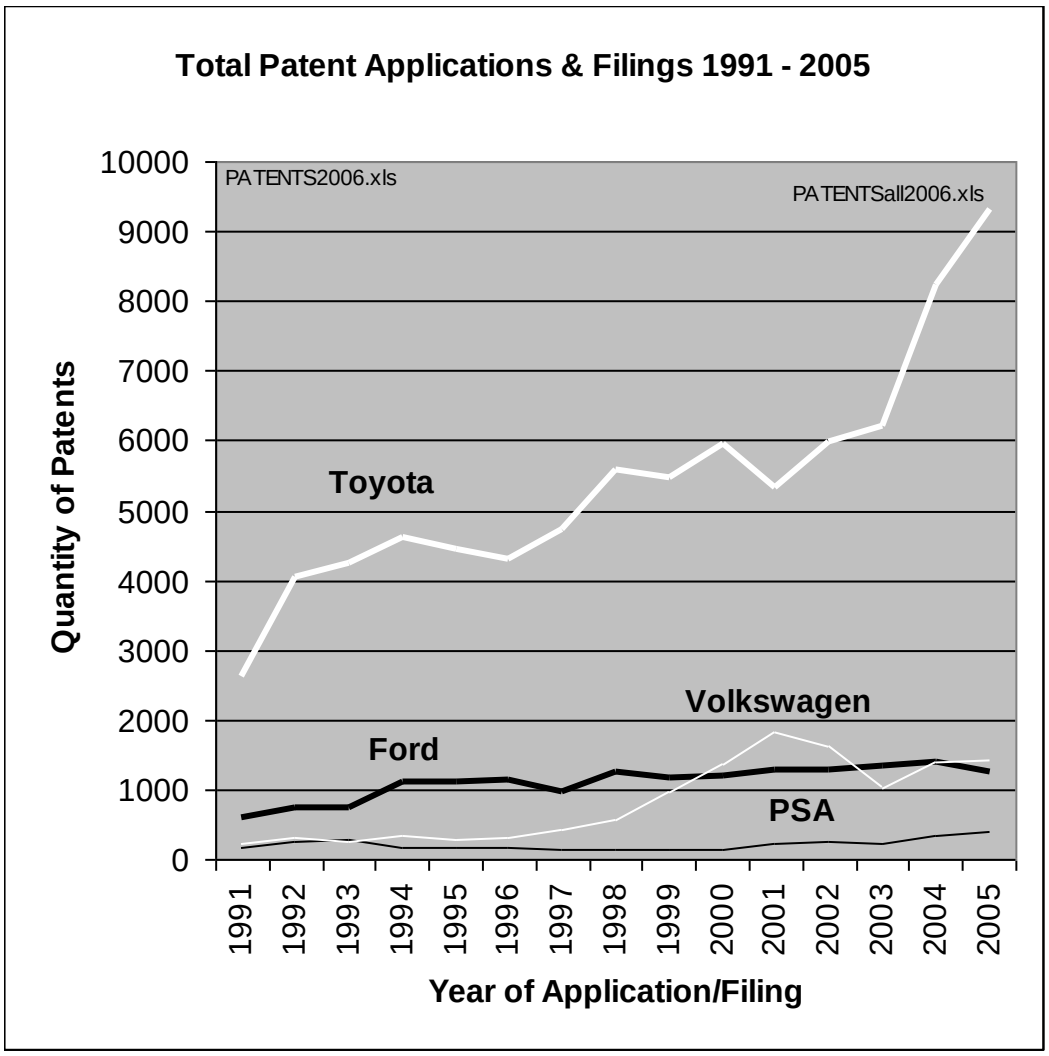

Figure 5.1: Total Patents Published by Toyota, Ford, PSA Peugeot Citroen and Volkswagen from 1991 to 2005

Difference in patent activity and overall trends between these large OEMs is clear. Toyota globally applied for and filed 2630 patents in 1991, far in excess of

the next closest Ford with 597 patents, and increased patent activity very rapidly to over 9000 patents in 2005.

Volkswagen, Ford and PSA Citroen Peugeot all indicate minor increase in patent activity throughout the period. Regarding absolute levels of activity within any period, the graphs show that Toyota is very focussed upon the importance of patents with Ford and Volkswagen showing comparable levels to each other at a much lower rate. PSA indicated the lowest activity.

At this point, the overall patent activity in the graph gives no clue to whether activity is based upon core or non-core intellectual property and one would logically assume that elements of both may be included however the graphs do indicate the importance of patent safeguards particularly identified by Toyota's activity. On this basis the trends may be further investigated as a means to identify some correlation between patent activity and core competency.

In order to focus a little more directly onto the case study specifics, the analysis was also conducted upon the European as opposed to the previously described global activity.

5.3 European Activity of Four Major OEMS – All Patents

In contrast to Figure 5.1, in Europe, Figure 5.2 shows Volkswagen to have greater patent activity than the other three. Volkswagen is only marginally ahead of Toyota in the overall rate of increase through the period. Both Ford and PSA whilst showing similar rate of increase are both separated substantially with Ford indicating a patent activity of more than double that of PSA. Within the Case

Study territory (Europe) there is a clear trend that both Toyota and Volkswagen are showing increased activity in patents compared to their rivals.

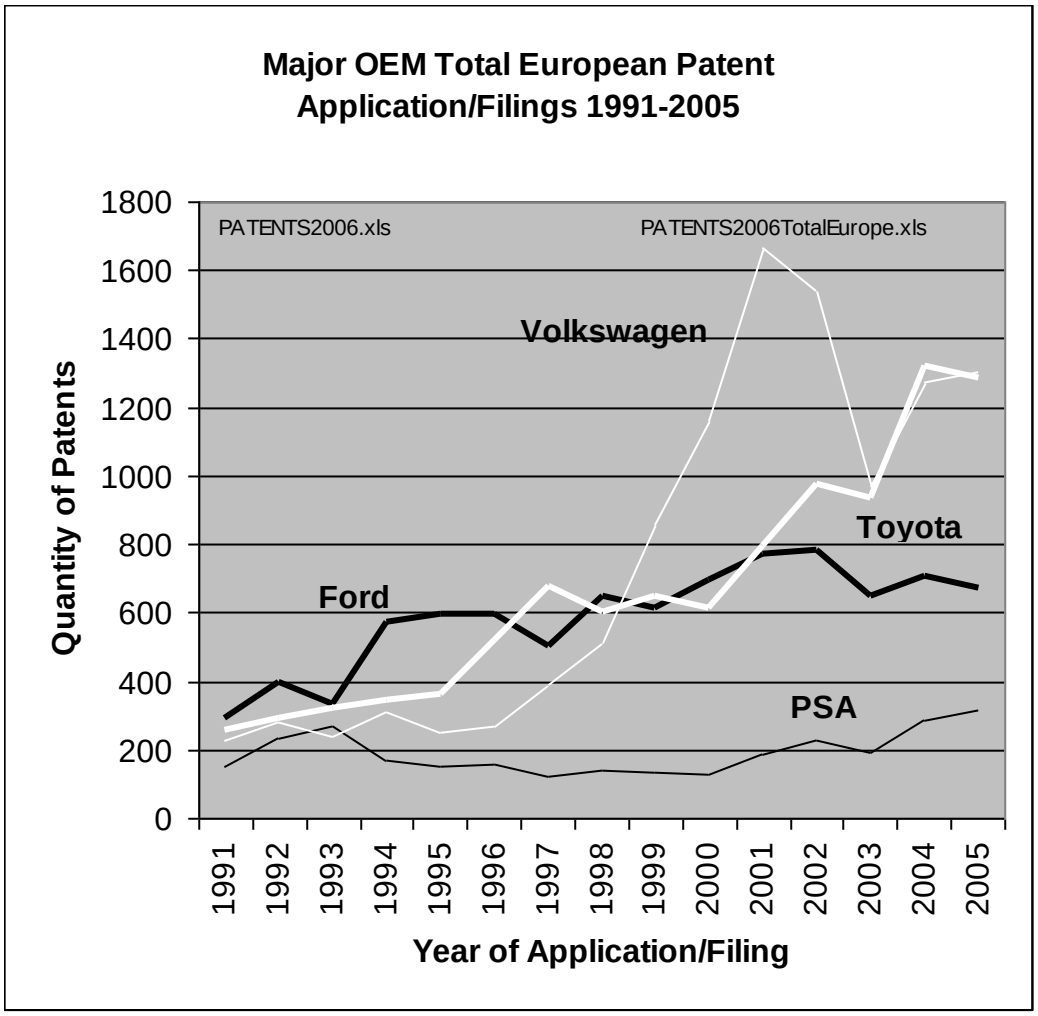

Figure 5.2: Major OEM Total European Patent Application/Filings 1991-2005

5.4 Global and European Patent Activity of Four Major OEMs – Fuel Tank.

A fundamental part of any automotive fuel system is the fuel tank. As this component is normally car specific, being dependent upon under-body construction with many other variable design criteria and vehicle attributes,

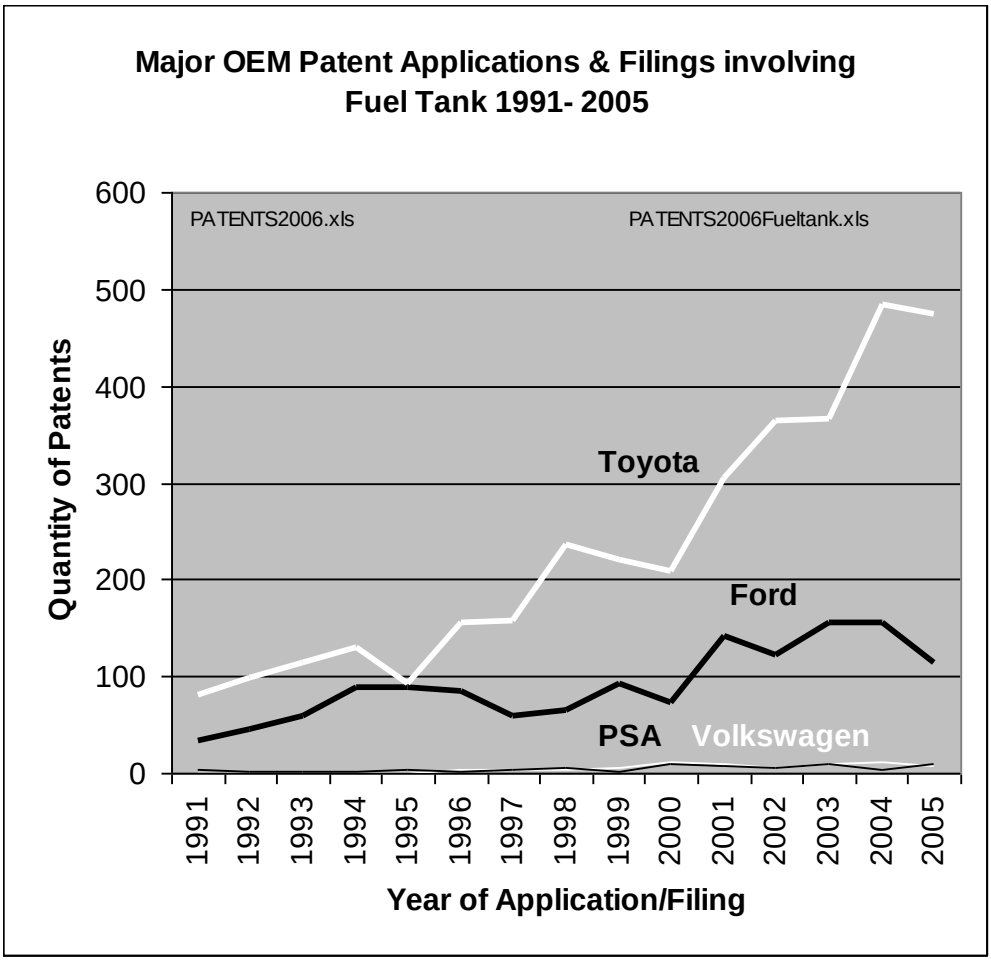

Figure 5.3: Global Patents Granted to Ford and Major Competitive OEMs Relating to "Fuel Tank" Search in Title or Abstract of Patent Text Between 1991 & 2005

OEMs have unique designs independent of each other. Based upon this, a further patent investigation was carried out to establish if the OEMs were assigning the associated intellectual competence to suppliers or not. On this basis a patent search was conducted using “Fuel Tank” as the word search criteria within the title or abstract of the patent descriptions.

Figures 5.3 and 5.4, as before identify the patent activity of the four major OEMs both globally and at European Level

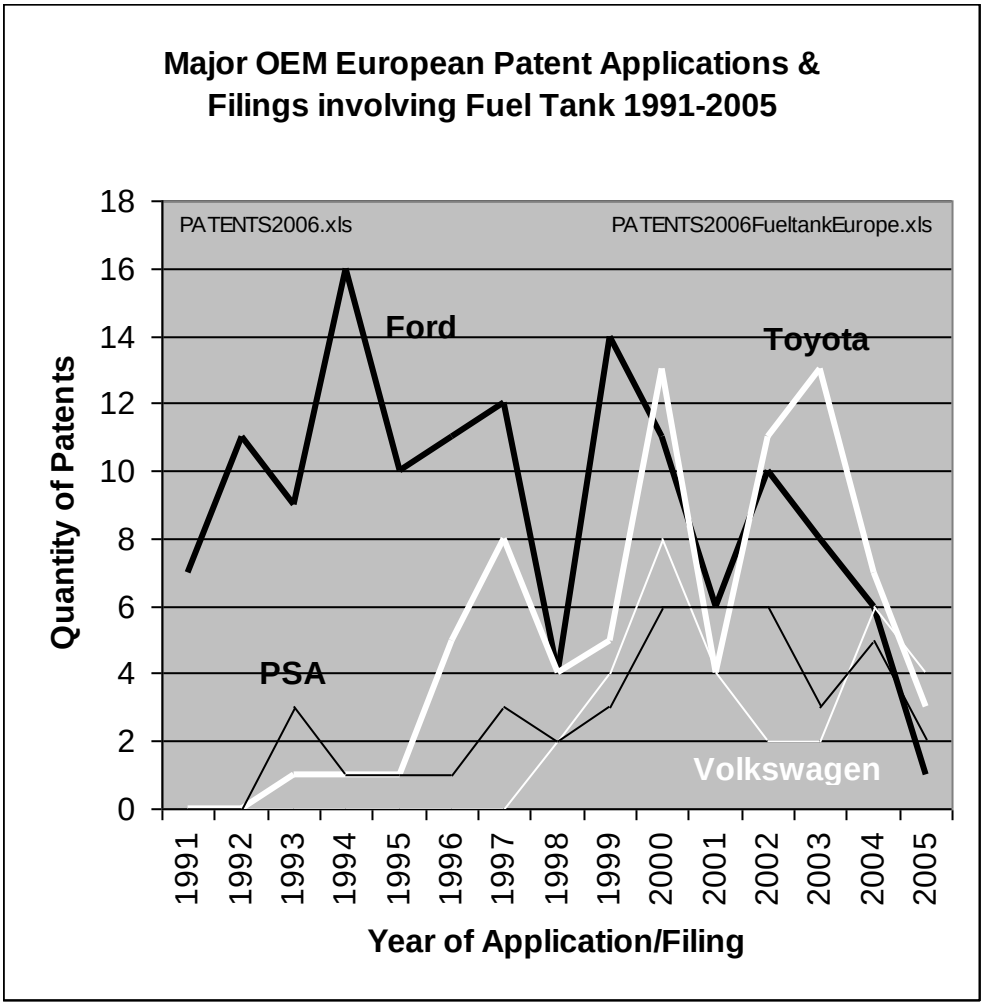

Figure 5.4: Patents Granted to Ford and Major Competitive OEMs in European Activity Region Relating to "Fuel Tank" Search in Title of Patent Text Between 1991 & 2005

Comparing Figure 5.3 and Figure 5.4, it can be seen that patent activity is much less in Europe compared to Global. At the more detailed level of patent searching, the number of patents is reduced and becomes much sparser. This makes it much more difficult to identify trends as shown in the European Patents (Figure 5.5) where Ford shows the maximum level in any one year of sixteen patents in 1994.

On the basis of the results presented in Figure 5.4, Table 5.1 provides a summary of the findings regarding relative patent activity of the four compared OEMs with respect to fuel systems. This is based upon the global patents due to the greater volume of patents and greater clarity regarding trends compared to the reduced volume of the European patents alone. Whilst this case study is focussed on European OEMs, the diversion in order to provide sufficient data through a Global view was justified in that all the OEMs are global in their activities.

Table 5.1: Patent activity status of Toyota, Volkswagen, PSA Citroen Peugeot and Ford relating to Fuel Systems.

OEM	Fuel System Patent Activity
Toyota	High-Increasing
Volkswagen	Low-Increasing
PSA Citroen Peugeot	Low-Increasing
Ford Motor Company	Moderate-Increasing

5.5 OEM Patent Activities in Comparison to Financial Performance

In order to rule out the extent of corporate finances affecting patent activity of the OEMs some snapshots were taken of the affected OEM's net income margin for 2002 (Figure 5.5) and research and development budget as a percentage of revenue (Figure 5.6).

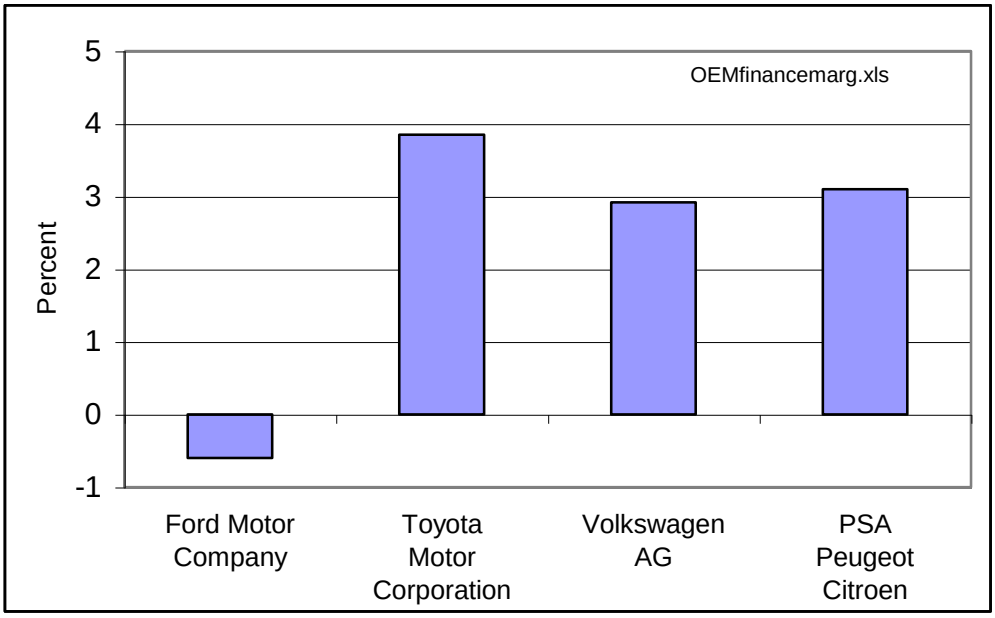

Figure 5.5: Comparison of Major European OEM Net Income Margin-2002 (PriceWaterhouseCoopers, 2003)

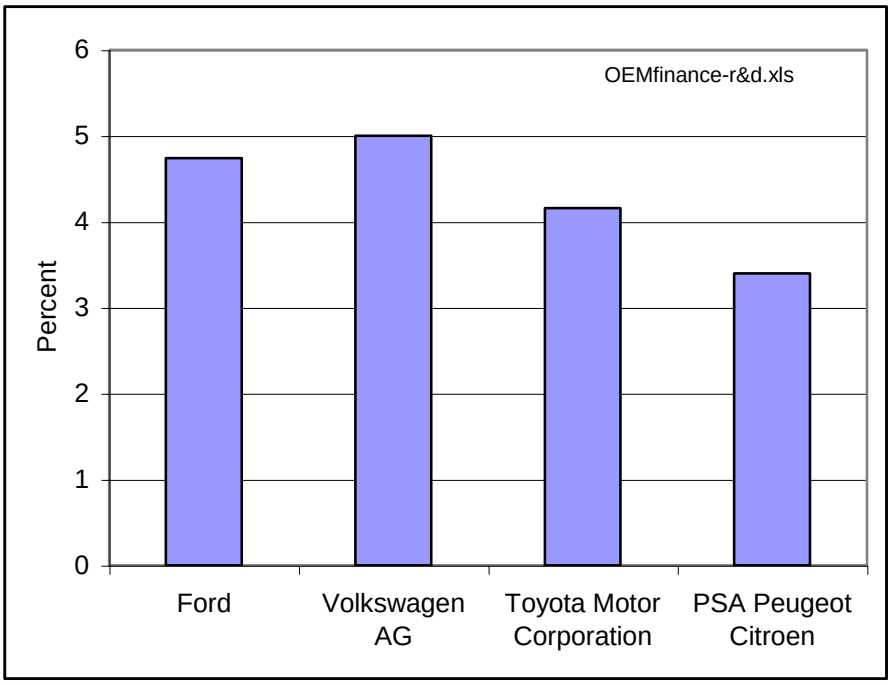

Figure 5.6: Vehicle Manufacturer Research and Development as a Percentage of Total Revenue-2002 (PriceWaterhouseCoopers, 2003)

Figure 5.5 identifies that Ford's income margin in 2002 was markedly lower than its competitors and was in fact negative; however this did not appear to cause a

major differential in research and development budget over the same period where Ford still exceeded Volkswagen and PSA development budget as a percentage of revenue. This indicates that Ford regards research and development into new products very highly. Similarly, whilst the patent activity in 2002 does show a pronounced dip (Figure 5.4), it is still within a trend of slowly increasing patent activity.

The research and development budget of the major OEMs would typically be the budget that funds the technological competence necessary to invent novel concepts necessary to base patents upon. It would appear therefore that patent activity is not driven by company profits but something deeper within the company. In order to progress and understand this, a comparison was conducted in relation to the various OEM's patent activity on fuel systems, their core values and outsourcing strategies.

5.6 OEM Patent Activities in Comparison to Core Values and Outsourcing Strategy

The following compares the patent activity for fuel systems compared to core values and outsourcing strategy for each OEM in turn to observe if the trends identified correlate to the individual OEM sourcing strategies.

Toyota

Auto Business Ltd (2002a) paints a clear picture of Toyota's views on core competency by stating that traditional core development and manufacturing activities are only handed over to suppliers where there are clear and lasting

gains to be secured. Toyota is unwilling to transfer too much to suppliers and instead emphasise joint development to retain key expertise. Toyota is reluctant to give suppliers “black box” responsibility and associated power through knowledge. Parts should be made internally if the company has the necessary knowledge and finances. This helps Toyota to retain knowledge to better understand the quality of similar bought in parts. There is also a resistance to further outsourcing due to Toyota's dependence upon "keiretsu" network of suppliers, a group of suppliers in which Toyota has minority holdings that effectively enables them to retain external expertise, internally.

A further clarification of Toyota's core values can be developed from their official website site (Toyota, 2002), “Through Monozukuri – manufacturing of value – added products” and “technological innovation, Toyota is aiming to help create a more prosperous society. To realize this, we are challenging the below themes”

1. “Be a driving force in global regeneration by implementing the most advanced environmental technologies.”
2. “Creating automobiles and a motorized society in which people can live safely, securely and comfortably”.

The above comments were be summed up by Deutsche Bank (2002) as “One of the world leaders in automobile technology including safety and environment”. Included within the above comments, environment and safety are clearly key attributes highlighted by Toyota and although fuel systems remain unmentioned their consideration is very implicit in both.

Clearly Toyota are reluctant to give up any traditional core competency in general and for fuel systems this is indicated clearly by their fuel system patent

activity and supported by the implicit nature of fuel systems within the safety and environmental aspects of their core values. In relation to this Toyoda Gosei, a part of the Toyota seeks to position itself to being one of the three largest suppliers of fuel tank modules by 2010 (Toyoda Gosei, 2004).

Table 5.2 illustrates the findings relating to Toyota and patent activity and Core Fuel Competency based upon this discussion.

Table 5.2: Toyota's Patent Activity Trends and Core Fuel Competency Status

OEM	**Fuel System Patent Activity**	**Core Fuel Competence**
Toyota	High-Increasing	In-house

Volkswagen

According to Auto Business Ltd (2002b) Volkswagen has no fixed policy for outsourcing and all decisions are made plant by plant. Volkswagen expects suppliers to provide significant technological input and wants core competency in design, vehicle integration and systems control to remain in-house. It continues to develop in-house capabilities for developing and assembling modules as part of its platform strategy.

The official website Volkswagen (2005) provides no major indication to whether or not fuel systems are considered core competency, "It is the goal of the Group to offer attractive, safe and environmentally friendly vehicles which are competitive on an increasingly tough market and which set world standards in their respective classes". Fuel systems do provide a focal role within safety and

environmental attributes and therefore could be viewed as a fundamental core element in offering the defined attributes.

The above indicators do not show a clear strategy towards viewing fuel systems as a core competency; however Volkswagen manufactured fuel tanks in 1996 (ITB Group Ltd, 1996) and were still doing so up until 2002. therefore it is highly likely that they at the very least want to retain some competency within the company. On this basis the low but increasing patent activity does show some correlation with the above quoted Volkswagen goal.

Table 5.3: Volkswagen's Patent Activity Trends and Core Fuel Competency Status

OEM	**Fuel System Patent Activity**	**Core Fuel Competence**
Volkswagen	Low-Increasing	In house

PSA Citroen Peugeot

According to Auto-Business Ltd (2002c), PSA prefers co-operative ventures with Suppliers and other OEMs to develop new technologies. They use between 100 and 150 Suppliers for joint development and other suppliers provide products based upon PSA development. Outsourcing decisions are based upon technical resources and emphasis on return on capital. Where internal resources cannot be justified they endeavour to avoid "shadow engineering", the practice of an internal engineer replicating the work of a supply engineer, so as not to duplicate costs although this is countered with a fear of losing certain core

engineering competency for ever and the need to gain competitive advantage through the increasing need for innovation.

This last comment is echoed within PSA Citroen Peugeot's official web-site PSA-Peugeot Citroen (2003a) “success lies in the carmaker's ability to bring out original and innovative vehicles in rapid succession.”

The following is also from PSA Citroen Peugeot's official web-site (PSA-Peugeot Citroen, 2003a):

"Innovation and areas of excellence; The Group is seeking to establish itself as a leader in the key areas of automotive technology, notably those linked to environmental issues, safety and comfort.

Group Strategy: Four strategic areas of innovation:

1. Improving all aspects of safety
2. Reducing fuel consumption and protecting the environment
3. Offering on-board experience and greater sensorial comfort.
4. Developing new vehicle concepts."

Similarly to Toyota and Volkswagen there is also a strong emphasis on safety and attention to environmental issues is also mentioned with PSA Citroen Peugeot.

The evidence above compared to patent activity does not clearly identify whether Fuel systems are a core competence of PSA Peugeot Citroen however their unwillingness to lose certain competences may indicate that they do maintain at least a moderate level of competency.

PSA are keen to capitalise on their intellectual prowess by the fact that they advertise that they file more than 300 patents every year, (PSA-Peugeot Citroen, 2003b)

Table 5.4: PSA's Patent Activity Trends and Core Fuel Competency Status

OEM	Fuel System Patent Activity	Core Fuel Competence
PSA Citroen Peugeot	Low-Increasing	Moderate In house

Ford Motor Company

The term Full Service Supplier (FSS) was instigated by Ford Motor Company in Ford USA and was further rolled out to Europe in over the period 1998-2000. The term reflected new roles for the suppliers that go far beyond the normal role of manufacturing systems, commodities and products.

Definition of Full Service Supplier; (Ford Motor Company Ltd b 1998)

"The Full Service Supplier has expertise in the design, development and manufacture of a commodity considered non-core to Ford. Non-Core commodities include those Ford believes are designed and developed with better understanding and efficiency by the supply base."

Responsibilities of a Full Service Supplier

The intent of using Full Service Suppliers is to "fully utilize supplier expertise in product development" in a partnership where the supplier performs "product design, engineering, validation, testing and manufacturing activities to support global programmes. In order to be recognized as a FSS, Ford Motor Company

requires the Supplier CEO to commit to principles and Roles & Responsibilities listed …" (Ford Motor Company Ltd, 2000e)

The roles and responsibilities, designated as either Supplier, Ford or shared, are identified as to specific phases in a vehicle programme and include the full spectrum of engineering disciplines.

This new FSS process effectively meant that Ford was outsourcing the intellectual competence to their suppliers based upon a core/non-core decision. The definitions used for Core and Non-core are re-stated as below (Ford Motor Company Ltd, 1999).

Core Commodity Definition

"# Commodity expertise is exclusive to Ford; and facilities do not exist or are highly limited outside of Ford.

Commodity cannot be designed, developed & engineered outside of Ford at a comparable level of expertise & efficiency

Commodity expertise must remain inside Ford due to strategic business and/or technical considerations."

Non-Core Commodity Definition

"# Commodity expertise is not exclusive to Ford; resources and facilities exist outside of Ford Motor Company

Commodity Suppliers have technology and product development capability.

#Commodity can be designed, developed and engineered with greater expertise & efficiency than at Ford."

In theory, the fuel system or any other system or components could be outsourced to a Full Service Supplier if it met the specific criteria.
Referring back to Mitzberg et al. (1985), the Full Service Supplier sourcing strategy appears to be a deliberate strategy that has developed into an emergent strategy within Ford Europe after initial rollout in the United States.
Ford considered that the fuel system was non-core and adopted FSS on fuel systems in Europe; however, the last definition relating to expertise and efficiency could only be verified through either outsourcing experience or through extensive benchmarking. Table 5.5 summarises the results of Ford's patent activity and outsourcing position, by adopting Full Service Supplier, regarding fuel systems.

Table 5.5: Ford Motor Company's Patent Activity Trends and Core Fuel Competency Status

OEM	**Fuel System Patent Activity**	**Core Fuel Competence**
Ford Motor Company	Moderate-Increasing	Outsourced

5.7 Global Patent Activity of Suppliers to OEMs – Fuel Tank

To provide a comparison of supplier to OEM regarding fuel system competency, further data was gathered using the same "Fuel Tank" search criteria for a total of seven major Tier one fuel system suppliers.

During the period of assessment, 1991–2005, some consolidations took place within the suppliers resulting in total of four. These four suppliers together share a global market share of 46% and almost 100% of the automotive polymeric fuel tank business, (Inergy Automotive Systems 2003). These consolidations were taken into account within the assessment by accumulating the results for the suppliers that were taken over and adding them to the sums for the final consolidated company.

The resultant companies identified after consolidation were Kautex Textron, Inergy, TI Group and Visteon. Inergy was the result of mergers of Plastic Omnium with Solvay and TI Group from the merger of TI with Walbro. All suppliers identified were key suppliers of fuel tanks and major related components. Figure 5.7 identifies the patent activity of the four resultant suppliers between 1991 and 2005. Despite limitations of observations due to low numbers of patents, without exception all suppliers are becoming increasingly active in filing patents.

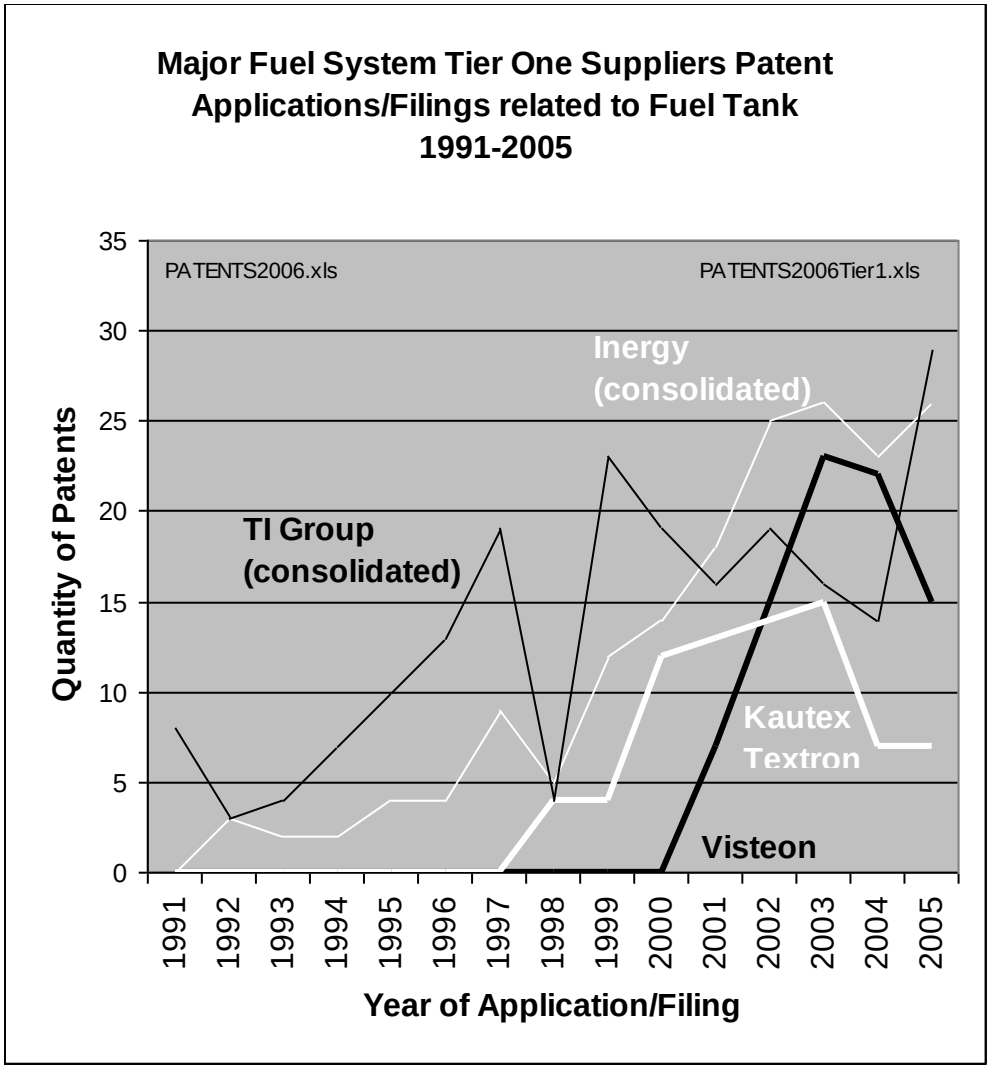

Figure 5.7: Patents granted to major Tier One Fuel System Suppliers relating to "Fuel Tank" search in Title or Abstract of patent text between 1991 & 2005

5.8 Summary of Patent Activity Related to Corporate Strategy

Table 5.6 compares the trends of patent activity between the major Automotive OEMs investigated and the affected suppliers derived within Case Study 1 Comparing the global fuel tank patent activity of Toyota and Ford with the leading suppliers (Figures 5.3 and 5.7) it is clear that the two OEMs are much more pro-active than the supplier groups. This is a somewhat contradiction to the

evidence suggested by Narula (2002). Toyota's peak performance was 484 fuel tank patents in 2004; Ford's was 156 in 2003 and 2004 both in different orders of magnitude to TI Group who peaked at 29 patents in 2005. The patent activity of the identified suppliers is similar in level to that of Volkswagen and PSA Peugeot Citroen.

Table 5.6: Patent activity status of OEMs compared to Suppliers.

OEM	Fuel System Patent Activity	Core Fuel Competence?
Toyota	High-Increasing	In-house
Volkswagen	Low-Increasing	In-house
PSA Citroen Peugeot	Low-Increasing	Moderate In-house
Ford Motor Company	Moderate-Increasing	Outsourced
Fuel Tank Suppliers	Low-Increasing	In-house

The data suggests that Ford was unique within its approach compared to the three major competitors listed. Despite evidence identifying that Ford was a leader in publishing intellectual property through patent filing it was adopting an approach of outsourcing its intellectual competence of fuel systems under the realms of the Full Service Supplier strategy.

Case Study 1 indicates that Ford was out of step with its major competitors relative to the outsourcing of fuel system intellectual competence and therefore at this point it would be hard to understand why Ford would be different to other OEMs.

Chapter 6: OUTSOURCING OF FUEL SYSTEM INTELECTUAL COMPETENCY RELATING TO "WHAT" AND "WHEN" CRITERIA

Chapter 5 highlighted the difference in strategic intent regarding the outsourcing of fuel system intellectual competency in comparison to three of its major competitors. Whilst Ford differs with the other OEMs, it has not yet been established whether or not this different approach is justified through individual test cases applied to the outsourcing model.

In order to ensure the relevance of this Chapter, Figure 4.4 has been reproduced as Figure 6.1 and highlighted to show the relevant parts within this Chapter.

The particular company represented is the Ford Motor Company Ltd, Europe which produces cars and small vans in manufacturing plants located all around the world. Despite this global manufacturing capability, most of the base engineering to design and develop these vehicles is based within Europe in Germany and the United Kingdom. Manufacturing volumes are in the order of 1.5-2.0 million vehicles per annum with some specific model lines approaching one million units at peak production.

Because at the time of research the outsourcing activities within case studies 2 and 3 was already in progress their application to the researched outsourcing decision model could only be fulfilled if the early criteria are investigated retrospectively. For instance, Step 1: Investigate and Step 2: Action as shown in Figure 4.2 would already have been implemented. However, the approach adopted for the two case studies was to review "What to Outsource" and "When

to Outsource" as part of Step 1: Investigate and concentrate on the "Why Outsource" (Verification) part of Step 3 to assess any benefits.

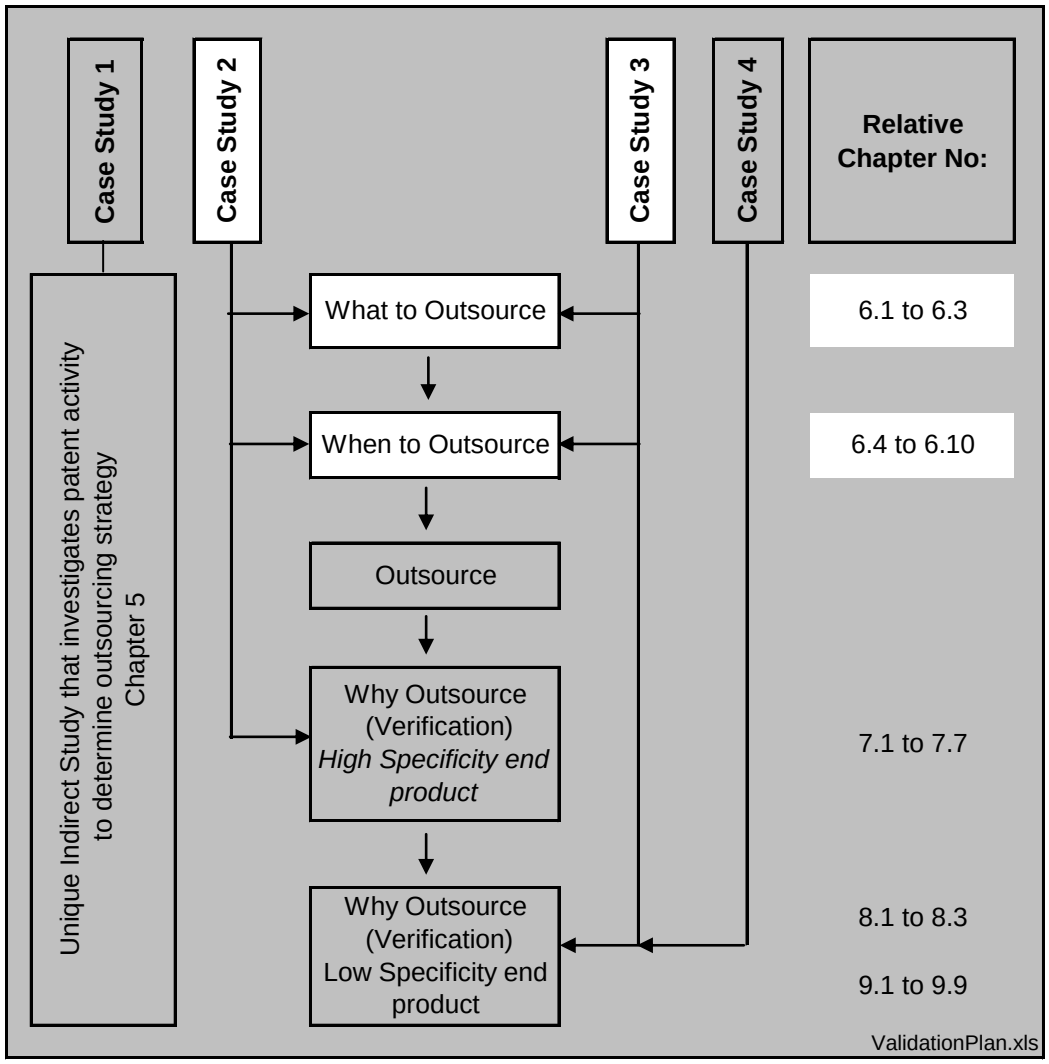

Figure 6.1: Outsourcing Decision Model Validation Plan highlighting aspects to be covered in Chapter 6

The two case studies relate to high and low specificity (Chapters 2.3.2 and 2.3 3) end products which is a unique factor that has not been addressed evidence, i.e. despite the outsourced entity (fuel system intellectual competence) having low

specificity, the end products that are ultimately bought in relating to this may possess either high or low specificity.

Common elements relating to “What” and “When” to Outsource for Case Studies 2 and 3 will be dealt with first within this Chapter.

6.1 What: Greater External Expertise

In order to establish if the expertise within the supply base was greater than that of the outsourcer, a competency measurement was devised in order to provide a basis for decision. The following describes the approach used at Ford Motor Company.

6.1.1 Competence rating of suppliers

A survey by using questionnaires was made of four major internationally represented suppliers. Of these suppliers, one was totally new to the OEM and part of a recent merger between two competitors, two were partially utilised historically and one was a commonly used partner in many programmes over previous years. The survey was used to establish the following:

(a) Are they competent to deliver a fully engineered fuel system.

(b) Do they have particular competence weaknesses that may need additional expertise provision, by Supplier or OEM.

(c) A benchmark to compare relative competence of competing suppliers.

6.1.2 Basis of supplier rating

The four suppliers were all rated on the basis of the matrix shown in Appendix 10, whereby they were requested to measure themselves within a rating scale of 1 to 5 (5 meets all requirements and 1 equals no experience) against a range of fuel system attributes e.g. fuel filling, delivery & storage (FUEL FUNCTIONS TO DELIVER) versus the competency/resources available within the supplier to enable delivery of specified attributes (ABILITY TO DELIVER FUNCTIONS). The attributes listed comprise those required to deliver a complete fuel system. The competency/resources comprise a list of expected knowledge, skills and facilities known to deliver the attributes with some additional requirements required specifically to interface with Ford. The matrix format (Appendix 10) was devised originally by Ford Motor Company in North America for similarly related purposes and was proven to be a useful tool. From the perspective that comparisons could be eventually made with European and American experiences it could provided synergies if fully utilised it in its full form with one minor addition. Within Europe, the automotive industry feeds an increasing demand for diesel powered vehicles, a situation that is different to the USA where gasoline vehicles pre-dominate. Due to this, the addition of particular attributes related to diesel fuel was seen as a necessary addition to the rating format.

6.1.3 Supplier selection

Many OEMs cultivate strong relationships with their suppliers forming long lasting relationships at all corporate levels and within numerous related

disciplines. This is the case for Ford as well but from the perspective of suppliers being able to supply a broader portion of a total fuel system compared to individual components it was necessary to review not only new suppliers but our current suppliers as well to ascertain their capabilities at the broader level. A fuel system comprises many components (Figure 6.2) often designed by OEMs and components/sub-systems supplied by smaller companies.

Within Ford, the fuel system was broken down into major subsystems/components all engineered with individual suppliers with Ford, in most cases providing the intellectual lead. The following is a list of such components that would have been supplied by individual suppliers:

Fuel Filler Cap

Fuel Filler Pipe

Fuel Tank

Fuel Delivery Module/Sender Unit

Fuel Tank straps

Fuel/Vent Lines

Fuel Filters

Carbon Canisters

In view of the complexity of the fuel system it is not surprising that not all suppliers stepped forward to take on the potential role of full service system suppliers, not only taking on their original historical roles but also taking on new responsibilities for co-ordinating the resources of other supportive suppliers (Tier Two) in a lead integration role. These lead suppliers provided the focus for

investigation and are referred to as Tier One Suppliers. The resultant Tier One suppliers (jointly self and Ford nominated for potential engagement) were all global fuel tank manufacturers reflecting the logistics necessary in matching the co-ordinating activities with Ford and the central role the fuel tank has in delivering the function of a fuel system.

A summary of the four suppliers selected for the survey is shown in Table 6.1. For future confidentiality of both suppliers assessed and resultant performance level the suppliers are referred to numerically. The table also provides a brief background summary of supplier's historic interface with Ford which will help in understanding aspects of performance in the context of the survey.

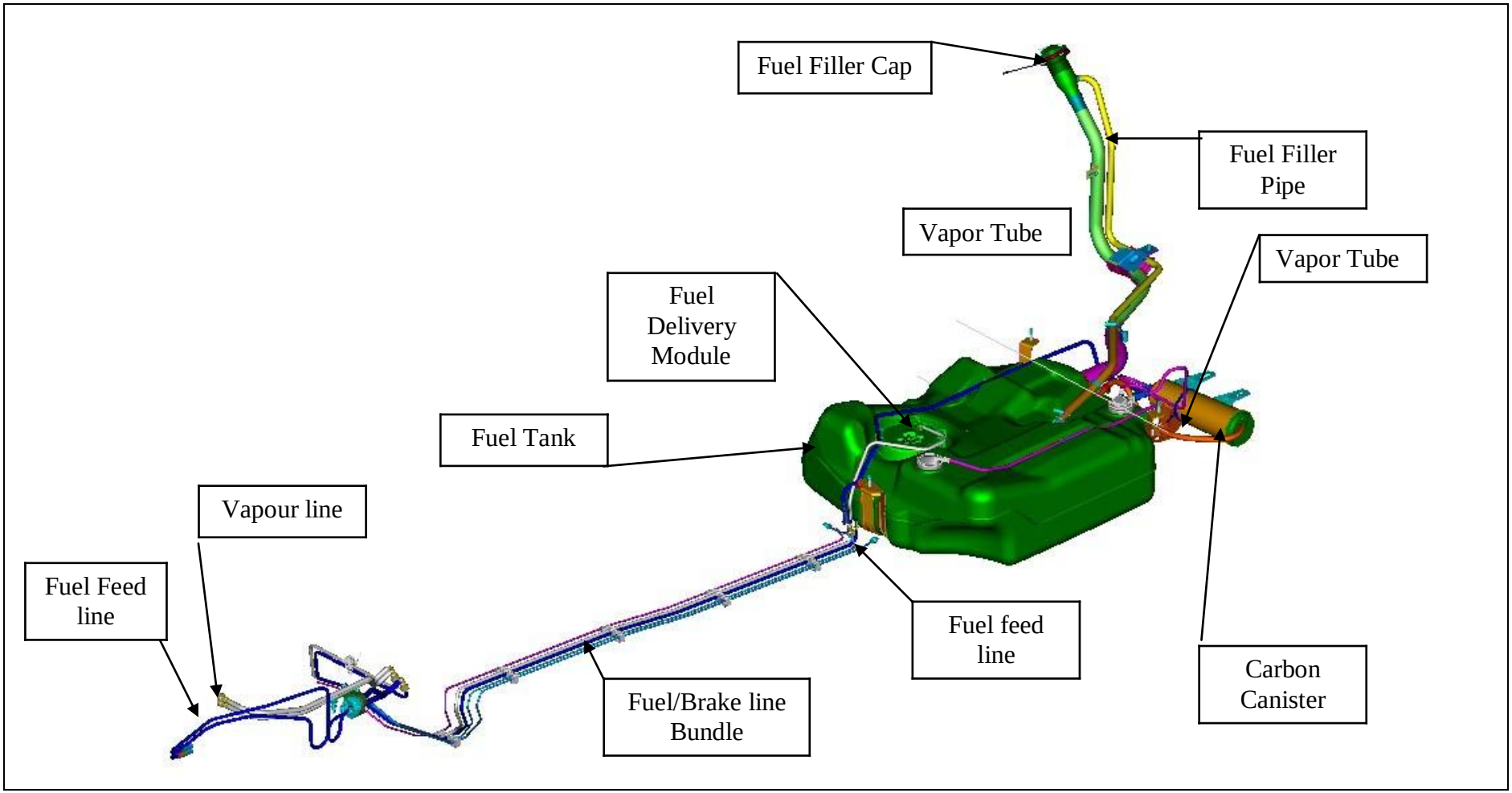

Figure 6.2: Typical Automotive Fuel System.

Table 6.1: Identification of Suppliers used in Survey

SUPPLIER	Background
1	Recently merged with another Tier One. Minor historic interface with OEM.
2	Much historic interface with OEM.
3	Some recent historic interface with OEM on specific technologies.
4	Much historic interface with OEM on very specific technologies.

6.1.4 Results of supplier survey

Within the duration of the survey it was disclosed that a merger would be taking place between two of the pre-determined suppliers. Therefore prior to formalisation of the independent results, further reviews were undertaken to provide a better indication of effects on the resultant new Tier One supplier beyond the date of the merger. The supplier review therefore reflects the results of only four Tier One suppliers thereby recognising the merged companies. Appendix 10 provides a combination of all four Supplier surveys with further columns shown indicating subsequent work where abilities and deliverable functions were averaged.

6.1.5 Observations from supplier survey (Appendix 10)

The supplier ratings reflected greater strength based upon their historical core competency related to manufactured products i.e. historic fuel tank manufacturers showed a high competence level in functions related to fuel storage and re-fuelling.
In contrast, expertise within commodities that are new to the suppliers was low.

Supplier 1 historically is a market leader where diesel powered vehicles are very popular and this is reflected in their engineering skills. In contrast to this, supplier 4 a long-standing supplier to OEMs for some key evaporative emission components provides the lowest average competence level (3.2) for vapour management.
Ford Motor Company Ltd (1999) states that a non-core commodity in the hands of an appropriate Full Service Supplier can be designed, developed and engineered with greater expertise & efficiency than at Ford. For a clearer picture of supplier performance one must look at OEM performance. In doing this, the same questionnaire distributed to the suppliers was given to three fuel system experts within the Ford fuel system department to provide a comparison to the suppliers. Using the same process as the suppliers, questionnaires were completed independently by the experts no overview of each other's results The three individual results were combined and an average assessment was reviewed individually and then further compared with the Supplier's ratings for comparison (See Appendix 11).

6.1.6 Comparison of supplier and OEM survey results (Appendix 10 & 11)

The overall OEM competency averaged at 4.3 compared to the Supplier average of 4.1 identifying that OEM had a marginally superior competency level overall. Within this assessment, the OEM competency relating to "OEM dedicated manpower was omitted so as not to provide an unfair advantage.
Two factors that provide a shortfall of OEM compared to suppliers, resulting in average ratings representing a “some experience” category were Development Test Facilities and Target-setting assistance. Whilst OEM test facilities were rated moderately low, the Development Test Experience category was rated very highly and equal in result to the Suppliers which identifies that high development test experience remains independent of having in-house test facilities.

6.1.7 Kepner-Tregoe analysis – Level of importance of competency used in supplier survey

In order to provide greater clarity of survey data, a Kepner-Tregoe Analysis was carried out on the results. The basis of this method is that all listed competency within the survey chart (1-12) are numerically rated and compared with each other by a team of four fuel system experts in order to obtain a hierarchy of importance compared for further analysis i.e. if "Target Setting" was seen as being equal importance to "Depth of Talent", it would be given a relative weighting value of 1, and if greater or lesser importance it would be rated as 2 or 0 respectively. The final outcome of the analysis (Appendix 12) provides a relative weighting of each competency once the sum of individual competency

ratings are added together and compared with the maximum potential rating of 2 for every comparison. The final weightings can then be multiplied by the supplier ratings (1-5) in thereby providing not only a competency level but a combined competency/importance of competence level identifying extremities of zero experience of low importance competency to meeting all requirements of a highly important competency (See Appendix 13). Finally the individual supplier weighted competency levels were plotted on a graph for comparison (Figure 6.3).

6.1.8 Discussion of survey results

The graphs (Figure 6.3) identify that Supplier 4 has a lesser competence than the other three who appear to be very similar in performance.

A significant drop off can be clearly seen in the competence of all suppliers regarding competency 12 (Knowledge of Customer/OEM). Whilst this aspect could be weighted either way, between knowledge of OEM and Knowledge of end customer i.e. the person who buys/drives the final car the rating from supplier 3 in this category was rated 3 on fuel tank storage. This supplier as identified earlier has a high knowledge of plastic fuel tanks and has been a long term partner to and subsequently is also very knowledgeable of Ford, therefore the shortfall must be attributed to end customer knowledge.

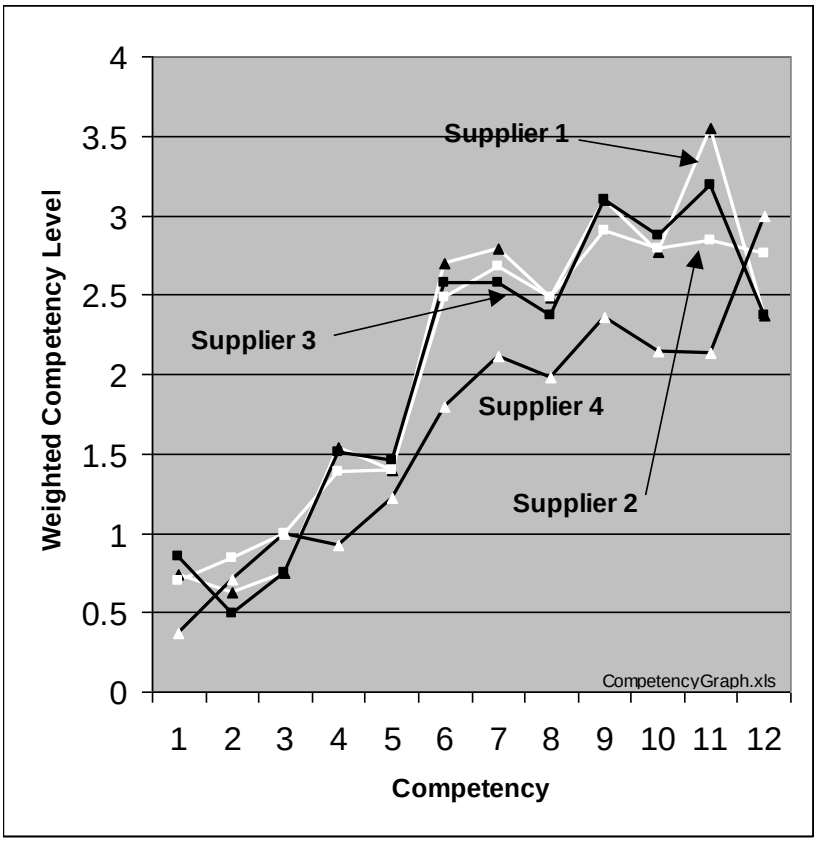

Figure 6.3: Individual Tier One Supplier, Weighted Competency Levels.

The shortfall is really in the end customer knowledge (Competency 12). This knowledge/competence as indicated through the Kepner-Tregoe analysis must be important for any supplier if they are to exhibit greater expertise & efficiency than their Ford based counterparts (Ford Motor Company Ltd 1999). End customer requirements derived from direct contact feedback is a key driver to the design of any fuel system and without this key information the supplier must be at a disadvantage. Dependency on the OEM to provide this interface can potentially eliminate the opportunity for a supplier to gain pre-eminence through obtaining first hand data in order to optimise new designs.

6.1.9 Direct comparison of supplier and OEM weighted competency level

The comments in Chapter 5.1.9 regarding competence 12 (Knowledge of Customer) related to a higher performance of OEM versus Supplier. Being more directly connected to the customers through various business interfaces at vehicle level provides the OEM with a distinct advantage. Figure 6.4 shows the weighted ratings of the three best suppliers 1, 2 and 3 and the OEM.

Referring to Appendix 13, the average overall weighted competency of OEM (2.18) compared to the best supplier average were (2.07) showed the OEM did have a minor advantage.

Comparative competence level within the OEM could be improved through enhanced performance data gathering of competitor system/component performance and also enhanced development facilities that would help resolve the former. Supplier performance would need to be improved through exposure to end customers in order to attain a first hand holistic view of their products in order to address a total engineering situation.

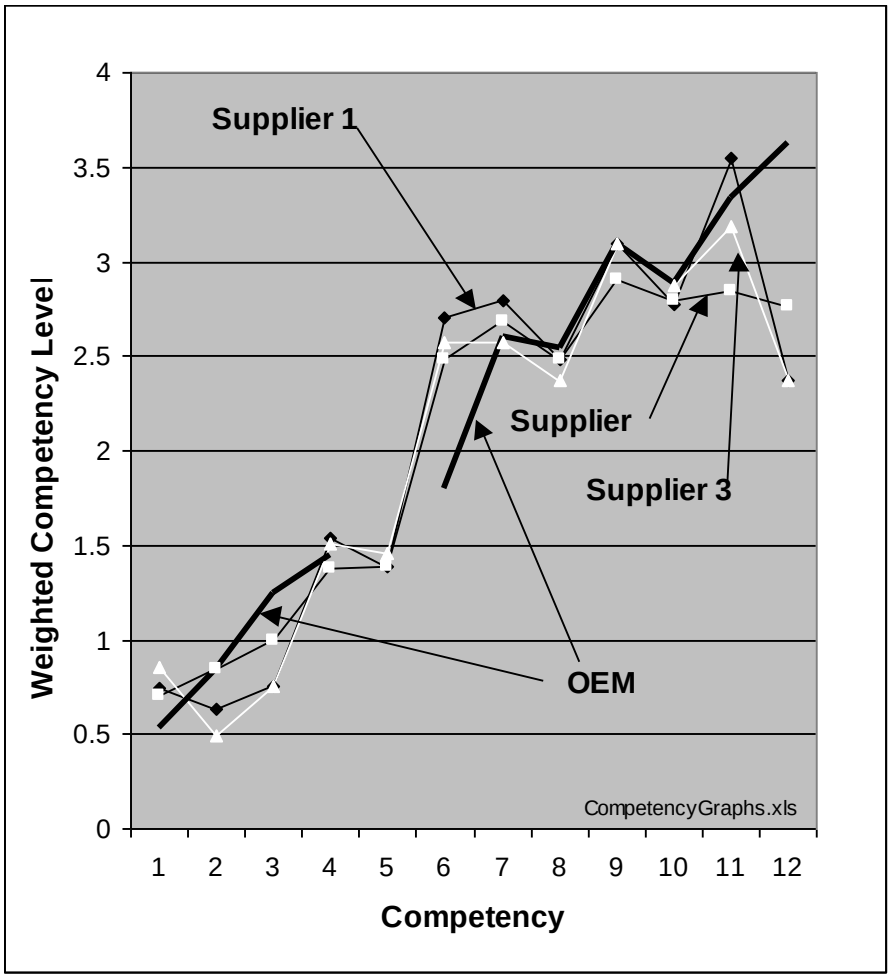

Figure 6.4: Competency Levels of Best Three Individual Tier One Suppliers Compared to OEM

In order to provide a measure of expertise in the Outsourcing Model using the resultant competency levels, the resultant average OEM weighted level was used against the best of the suppliers. This provides an advantage of +5% in favour of the OEM and therefore, on its own would not suggest that outsourcing is justified.

For inclusion in the outsourcing model, the suppliers were therefore seen as **5% inferior to OEM with respect to "Greater external expertise" i.e. minus 5%.**

6.2 What: Low Specificity

It is important to re-iterate what is being analysed here regarding specificity. It is the outsourcing of intellectual competency regarding fuel systems since outsourcing of the actual commodities was already in place. It is however, necessary to explain the detail of the fuel system in order to understand the specificity of the competency that is necessary to design and develop it.

The fuel system of a motor vehicle plays an extremely small part in a decision to buy a particular model. The interface between a customer and the fuel system is solely between the filler cap and filler pipe during the process of refuelling and the level of fuel represented on the fuel gauge within the instrument control panel. Despite this, there are inherent dependencies the customer may have on the fuel system that are unknown to the average person represented in various attributes within a vehicle. The below list provides some of these dependencies.

Safety: Within crash conditions, a customer needs the fuel system to withstand a high degree of integrity from leakage.

Evaporative emissions: A vehicle needs to meet stringent fuel evaporative emission requirements at various levels in various global territories. The vehicles must not only meet these requirements when the vehicle is new but also throughout its life and therefore the auto manufacturer must ensure the systems are relatively foolproof and robust to environments and market conditions.

Fuel Economy: Fuel system design does have a part to play in fuel economy, albeit a small part. The power consumption of fuel pumps must be optimised to ensure they only provide power at minimal levels.

Cost: Fuel systems like any other part of a vehicle must be cost effective.

The above points indicate that there is some minor specificity that may affect fuel system commodities but not all are affected to the same degree. Taking crash testing for example, whilst all commodities must provide a high degree of robustness to leaks in a crash, some are less likely to be affected than others, dependent upon their vulnerability.

This point is relevant to all OEMs. Location of fuel system components within a vehicle in combination with individual corporate specifications is a driver for numerous unique system architectures across and within the OEMs.

6.2.1 Summary of fuel system specificity

The above comments indicate that the specificity of fuel systems is potentially very high in individual components within the final delivered product. The requirements that drive this however are normally very generic in their nature. Primarily because it is not a major system that affects a customer purchasing decision the system only has to meet specific packaging and functional specifications laid down by the OEM. Whilst OEM specifications may vary and not follow a common standard, the generic differences are generally well established, well known by both OEMs and Suppliers. Whilst individual end products (components) may be highly specific to an OEM or vehicle, the intellectual competency necessary to engineer the systems is more generic if supported by OEM and legal requirements.

Therefore as shown in Table 6.3 the **"Low specificity" will be defined as yes, i.e. (+100%)**

Table 6.3: Resultant advantage regarding "Low Specificity" associated with outsourcing of fuel system external expertise.

	Conditional Criteria
Pre Outsourcing Status	Met = +100%
Outsourced Status	

6.3 Summary of "What"

The "What" criteria have all been covered within this Chapter with the exception of "Expertise is non-strategic". As this has been covered within Case Study 1 it is repeated here in the same format as others within this Case Study for completeness (Table 6.4)

Table 6.4: Resultant advantage regarding "Expertise is non strategic" associated with the outsourcing of fuel system external expertise.

	Conditional Criteria
Pre Outsourcing Status	Met = +100%
Outsourced Status	

Based upon Table 4.2, the non-core competency drivers that would support an outsourcing decision and the evidence within this chapter and Chapter 5 (Case Study 1), Table 6.5 summarises the evidence so far regarding the outsourcing of fuel system intellectual competency.

Table 6.5: Evidence to Support "What to Outsource" Relating to Fuel System Intellectual Competence

Non-Core Competency Driver	**Evidence Supporting the Decision to Outsource**	**Reference**
Greater external expertise	-5%	Chapter 5.1
Expertise non- strategic	100%	Chapter 4.6
Low specificity	100%	Chapter 5.2

6.4 When to Outsource Fuel System Engineering Intellectual Competence

Since within the case studies the decision to outsource fuel system intellectual competency had already taken place it was decided to eliminate the reasons "Why" at this point in order to concentrate on "When". Since the reasons why would be reviewed within Step 3 of the Outsourcing Decision Model (Figure 4.2) in order to verify if outsourcing was successful or not it has not been omitted overall. Normally the reasons to outsource would be established and known prior to outsourcing but the case studies represented within this Thesis are all retrospective. On this basis it now remains necessary to establish if the "When" criteria are positive in support of outsourcing. Reflecting upon the stages of industry life cycle (Appendix 2), (Lynch, 1997) it is tempting to align the outsourcing of intellectual competence immediately with either the Maturity or Decline phases as many aspects defined would provide a good match. Since the case is particular though, a review should be made relative to the facts associated with the subject matter i.e. outsourcing of intellectual competence related to fuel systems engineering in Ford Motor Company Ltd. The following looks at the individual points in more detail.

6.5 When Risk Intensity is Low

The risk in question here is related to the technology. Fuel systems have changed significantly over recent years but now within the global context there is a variety of system technologies available within most OEMs including Ford to provide a system that meets most of the foreseeable technology shifts in the future regarding evaporative emission levels, safety and other aspects relating to legal directives and/or customer requirements based upon conventional gasoline and diesel technologies. With the increasing pressure on environmental issues many OEMs are researching developments of electric cars and hybrids that could ultimately remove the need for fuel system as used on current vehicles. The strongest contender of these new technologies is the fuel cell which is an electrochemical device that converts a fuel's energy directly into electrical energy (Deutsche Bank, 2002a), removing the need for a conventional fuel system. Technology issues, the necessary infrastructure in the form of filling stations for Hydrogen or Methanol provide limitations on the introduction of fuel cell passenger cars in the and even in the next 20 years, significant penetration rates are expected to be low (Deutsche Bank, 2002a).

Whilst OEMs are looking at new cleaner methods of powering cars for the future they are predominantly dependent upon new technologies, not developments of current technologies i.e. conventional fuel systems. In this respect, technology is not expected to change significantly and therefore the risk intensity associated with losing or reducing fuel system knowledge and outsourcing intellectual competence must only present a minor risk therefore **"Risk Intensity is low" is positive and supports outsourcing (+100%)** as shown in Table 6.6.

Table 6.6: Resultant advantage regarding “Risk Intensity is low” associated with the outsourcing of fuel system external expertise

	Conditional Criteria
Pre Outsourcing Status	Met = +100%
Outsourced Status	

6.6 When Internal Transaction Costs are high

In Chapter 2.4.3 Leuliette, (2002) makes the point that the "traditional big three" which includes Ford are high cost producers carrying cost penalties in management overhead, labour and benefits. According to Noe, (2005), Industry experts estimate that for every car sold by a US carmaker, $1500 is paid out in healthcare benefits which climbs to $2000 when pensions are included; (Noe, 2005). Both Delphi and Visteon, individually spin-offs from General Motors and Ford are major suppliers of automotive fuel systems. Wages at Visteon are currently on par with Ford Motor Company due to a spin-off agreement, but these wages are seen as too high compared to similar competitors such as Johnson Controls Inc where compensation is just over half of that paid by Visteon; (Bloomberg, 2006). These examples show that despite having high internal costs, an OEM may not necessarily gain an advantage by outsourcing as it would be highly dependent upon whom the selected supply is and confusion with company accounting practices can make this comparison very difficult (Humphreys et al. 2002)

With these facts in mind, the high internal cost question regarding the outsourcing of intellectual competence for fuel systems must be very variable and therefore not a convincing case. The model will reflect this decision as **Neutral i.e. 0% for high internal costs** as identified in Table 6.7.

Table 6.7: Resultant advantage regarding "high internal costs" associated with the outsourcing of fuel system external expertise.

	Conditional Criteria
Pre Outsourcing Status	Neutral = 0%
Outsourced Status	

6.7 When Technology is Moving too Rapidly

Chapter 6.6 described a situation whereby the technology is relatively static, however in the case of fuel cells or any other alternatives eventually taking over, it would be likely that an OEM would look to reduce its fuel system competency levels and either concentrate on the new technologies and build up a resource with relevant expertise or alternatively let suppliers and competitors carry out a high proportion of the initial development. Any new developments may inevitably have some development dead ends where technology is proven unviable or infeasible. Whilst these efforts may boost knowledge and ultimately pave the way for a more acceptable alternative, the effort may still be very costly.

Former Chairman and Chief Executive Officer William Clay Ford, over the duration of this research project was publicly known for his positive views on

environmental issues. Ford Motor Company is actively looking at developing hybrid gasoline power-packs, partial hybrid technologies, Hydrogen internal combustion engines and Hydrogen fuel cells; (Ford Motor Company Ltd, 2006). In a speech in Dearborn, Michigan, USA relating to innovation on hybrid engine technology William Clay Ford made the comment "Whenever technology has been available, Ford has a strong history of sharing it with others to benefit the community" (Ford, W., 2005). This is exemplified by the joint development of fuel cell technologies with Daimler Chrysler; (Ford Motor Company Ltd, 2006) A reflection of the comments above to the major changes potentially coming in power technology does indicate again, **a positive situation for "Fast moving technology" supportive of outsourcing (+100%)** as identified in Table 6.8.

Table 6.8: Resultant advantage regarding "Fast moving technology" associated with the outsourcing of fuel system external expertise.

	Conditional Criteria
Pre Outsourcing Status	Met = +100%
Outsourced Status	

6.8 When There is a Chance of a Strategic Block

A strategic block may develop unbeknown to the decision makers associated with outsourcing i.e. there may always be a situation whereby a competitor or supplier comes up with a new invention that provides some major cost or technical advantage. This possibility must always present an element of risk. However, the previous chapters do portray a system that is very mature in its

development and therefore the chance of a strategic block must be low, **indicating a further positive indicator for outsourcing with small chance of a strategic block (+100%)** as identified in Table 6.9.

Table 6.9: Resultant advantage regarding "chance of a strategic block" relating to outsourcing of fuel system external expertise.

	Conditional Criteria
Pre Outsourcing Status	Met = +100%
Outsourced Status	

6.9 When Volatility is High

In 2003, Ford Motor Company celebrated 100 years of automotive manufacture; (Banham, 2002). This came at a time when there was much competition within the automotive industry in general. There is a constant drive to maintain profits in a time of intense pressure from developing low cost car producers from abroad (Shirouzu, 2003) and an underlying excess manufacturing capacity above ten million vehicles per annum (Figure 6.5).

Within this period, businesses have also been hit by increased oil prices, a weakness in global demand and a slump in equity markets Ford, W., (2003). To combat this, many manufacturers resorted to incentives in order to sell vehicles, a mature market phenomenon, shifting the basis for competition to pricing rather than product. For example, the monthly Alliance & Leicester Car Price Index identified that the price of average car cost fell from £13,600 to £12,000 in the period 1998 to 2003 (PricewaterhouseCoopers, 2001). Taking inflation into account this indicates a decline of 20.4% in real terms (Johnston, 2003). The

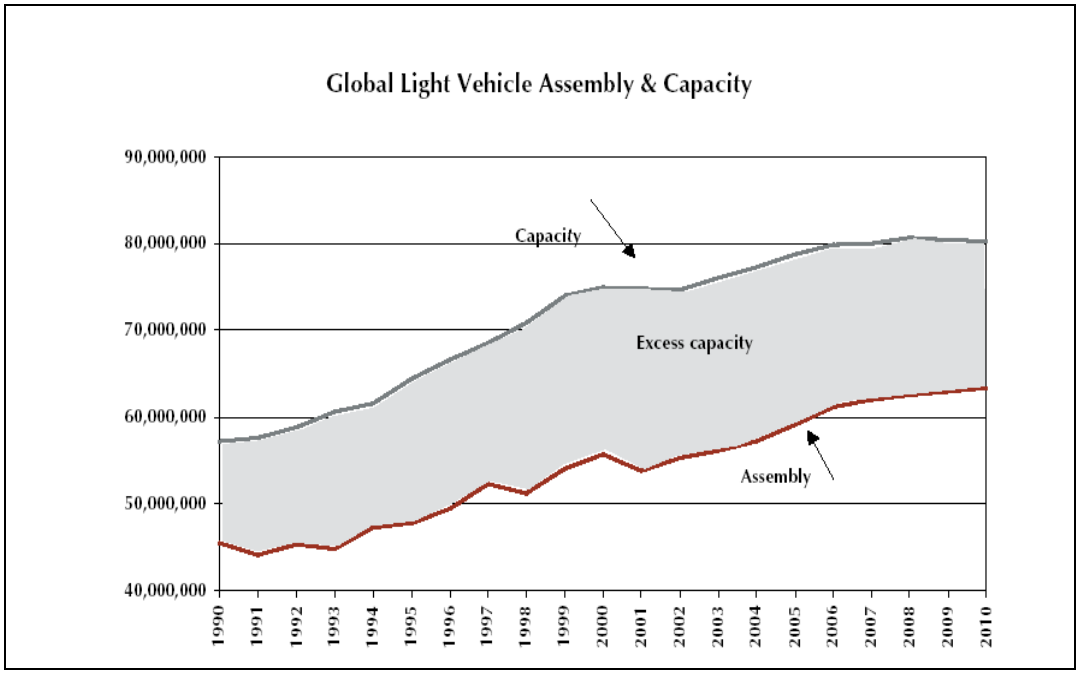

Figure 6.5: Global Light Vehicle Assembly and Capacity (PricewaterhouseCoopers, 2003a)

burden of supporting excess capacity and intense pressure on pricing has also affected Ford Motor Company who in the two years preceding May 2003 lost $6 billion (Fonda et al. 2003).

Within this period, many automakers are also consolidating in order to gain efficiencies (Figure 6.6). In 2002 global mergers and alliances reached a total of 621 transactions with deals totalling $35.1 billion (PricewaterhouseCoopers, 2003) including major takeovers of large OEMs involving the likes of Nissan, PSA and General Motors. This is illustrated by the fact that in the 40 years preceding 2002 independent automobile manufacturers have dropped from 52 to 12 (Deutsche Bank, 2002b).

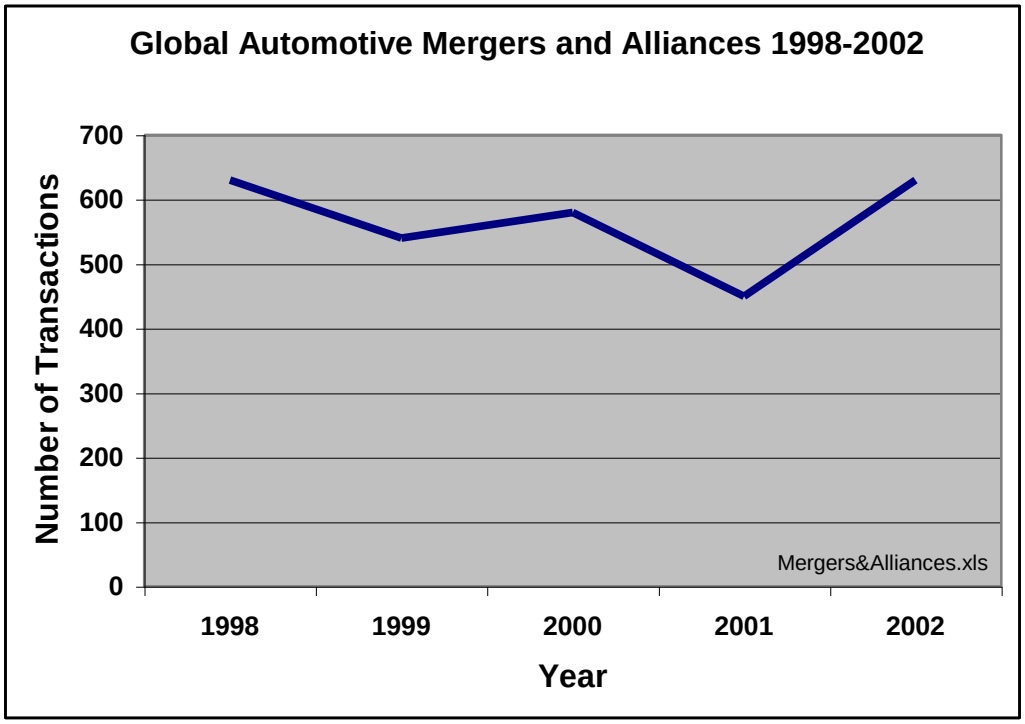

Figure 6.6: Global Automotive Mergers and Alliances 1998-2002 – (PricewaterhouseCoopers, 2003)

Summarising the above, volatility was extremely high for Ford Motor Company making the possibility of shedding some internal resources to the supplier base a tempting proposition in order to reduce losses and increase shareholder value. Indeed, the "**When?" to outsource is very clearly positive regarding volatility (+100%)** as identified in Table 6.10.

Table 6.10: Resultant advantage regarding "volatility is high" associated with the outsourcing of fuel system external expertise.

	Conditional Criteria
Pre Outsourcing Status	Met = +100%
Outsourced Status	

6.10 Summary of "When"

Chapter 6 covered the common aspects, "What" and "When" of Case Studies 2, 3 and 4 relating to the outsourcing of fuel system related intellectual competency. So far the evidence identified that the suppliers have marginally less expertise. As stated at the beginning of the Chapter, the outsourcing had already been started prior to the start of this research and therefore its potential destiny was already set. Using the suggested method of display as described in Chapter 4, the summary of results from this Chapter is illustrated in Figure 6.7.

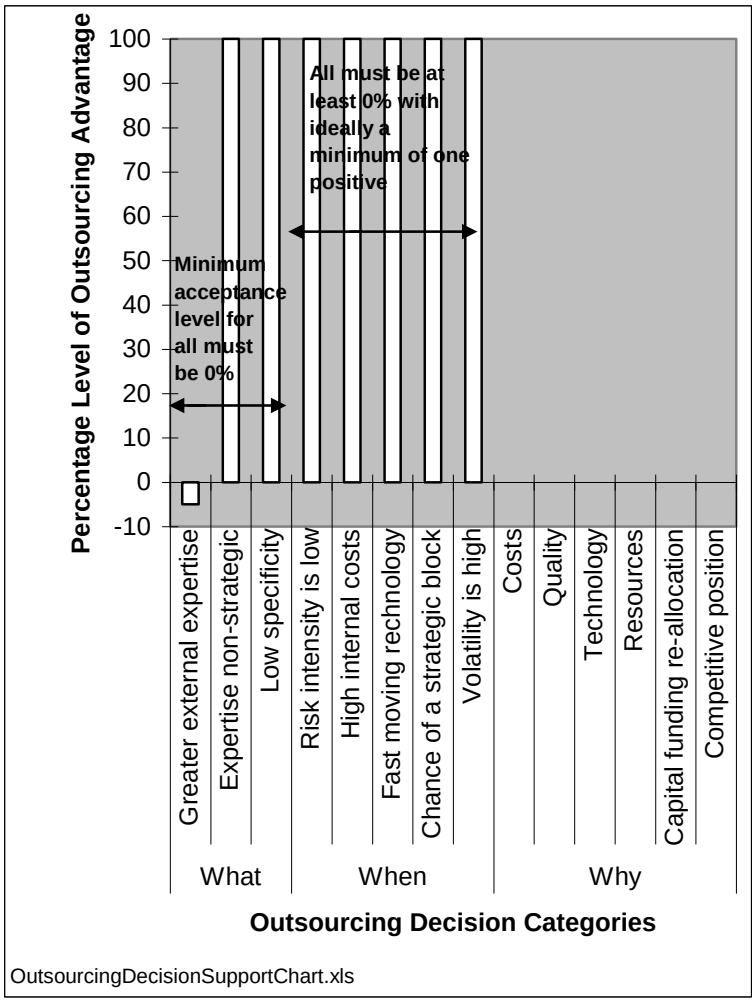

Figure 6.7: The completed "What" and "When" Criteria for Outsourcing of Intellectual Competence for Fuel systems

Chapter 6 has covered the common “What” and “When” elements within the developed Outsourcing Decision Model of Case Studies 2 and 3 relating to high and low specificity *end products* respectively.

The following Chapters 7 and 8 will cover the specific “Why” elements for each of the two fore mentioned cases studies bearing in mind that in both case studies the outsourcing was already underway.

Chapter 7: CASE STUDY 2 – OUTSOURCING OF INTELLECTUAL COMPETENCY RELATING TO A HIGH SPECIFICITY END COMMODITY

So far within Chapter 6 the outsourcing decision model process Step 1, "What" and "When" fields have identified that outsourcing should not progress. The investigation will now follow into the "Why" field to understand if the results of outsourcing were positive despite this finding.

Similar to Chapter 6, for clarity, Figure 4.4 has again been reproduced and

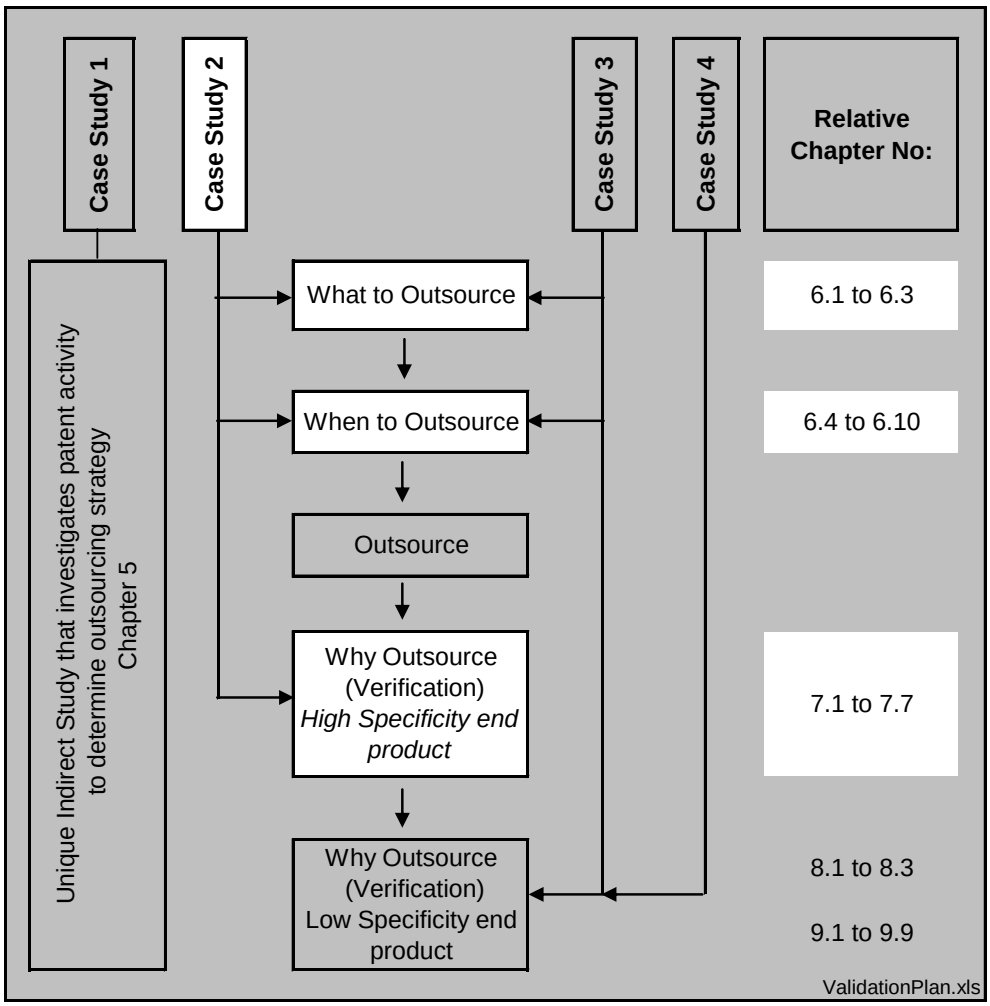

Figure 7.1: Outsourcing Decision Model Validation Plan highlighting what has already been covered in Chapter 6 and what will be covered in Chapter 7 relevant to Case Study 2

highlighted to identify what has been accomplished so far for Case study 2 and what Chapter 6 will be covering.

7.1 Why: Costs

From an engineer's perspective, costs are very difficult to ascertain accurately. Whilst an engineering organisation must work to achieve optimal costs at the same time as meeting product functional targets it is the purchasing organisation that directly handles and controls costs. For example the purchasing organisation may increase piece cost in order to reduce a tooling charge or may increase the price of one product line in order to reduce another. This makes life very difficult to offer definitive costing evidence. However the results of an initiative involving Ford Motor Company and three of its brands namely Jaguar, Land Rover and Volvo provided some clues as to the company viewpoint as to whether or not the resultant Full Service Supplier initiative provided reduced costs. This initiative was based upon a drive to find synergies between the brands in order to optimise combined use of resources, product performance and cost. Team composition comprised of key engineering and purchasing experts from all brands aligned with appropriate part time experts as required. The two examples used are both fuel system commodities, both with low specificity but are not identified here for reasons of confidentiality.

Product One:

Based upon cost estimates derived by specialised cross-brand representatives of the OEMs, it was estimated that the gaps between current bought prices and

estimated value was between 14% and 20% above estimates dependent upon brand and supplier. Despite the three brands using product technologies that differ in specification and execution these gaps are significant.

When looking at these figures is important to understand how the economies of scale influence the prices particularly when comparing a low volume Land Rover derivative with a high volume Ford. To answer this, it must be understood that the products are of low specificity and are supplied not only to the fore-mentioned automotive brands but to other auto-makers globally. Whilst manufacturing of these products may be localised to Europe, overheads of product design and development are shared at a potentially global level.

A further look at Price/Volume curves provided by two key suppliers of a similar and interchangeable component identified two totally different trends (Figure 7.2). The only difference between the two commodities is the technology, both in design concept and manufacturing processes; however both meet the same specifications.

Supplier one shows no variation between cost and given production volumes. This may be an exhibition of the fact that commodity is generic, shared between other car manufacturers and therefore given volumes have zero effect on the price.

Supplier two indicates a 22% reduction in cost dependent upon volume. Whilst this product cost does indicate a potential to eliminate the identified cost gaps, its origin is somewhat questionable for the same reasons identified for the previous suppliers trend line.

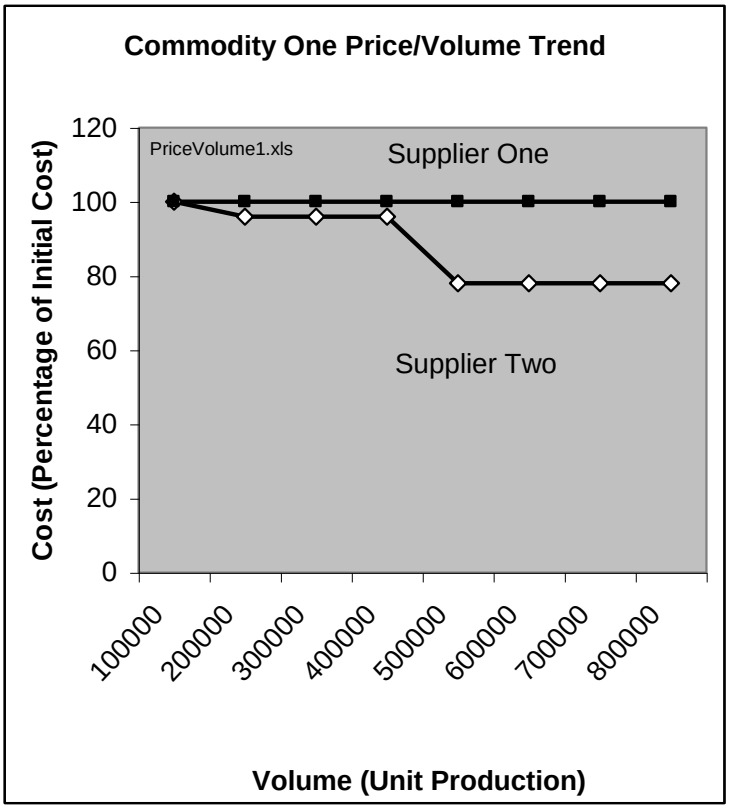

Figure 7.2: Piece Cost/Volume Relationship, Product One

Product Two:

This commodity is generic; however it is tuned to provide variants suitable for individual ranges of products. The total production volumes as indicated below in Figure 7.3 represent the total of all variants.

A benchmarking study based upon offerings from current suppliers and some major competitors identified cost gaps of between 9% and 20% compared to current prices dependent upon supplier and brand.

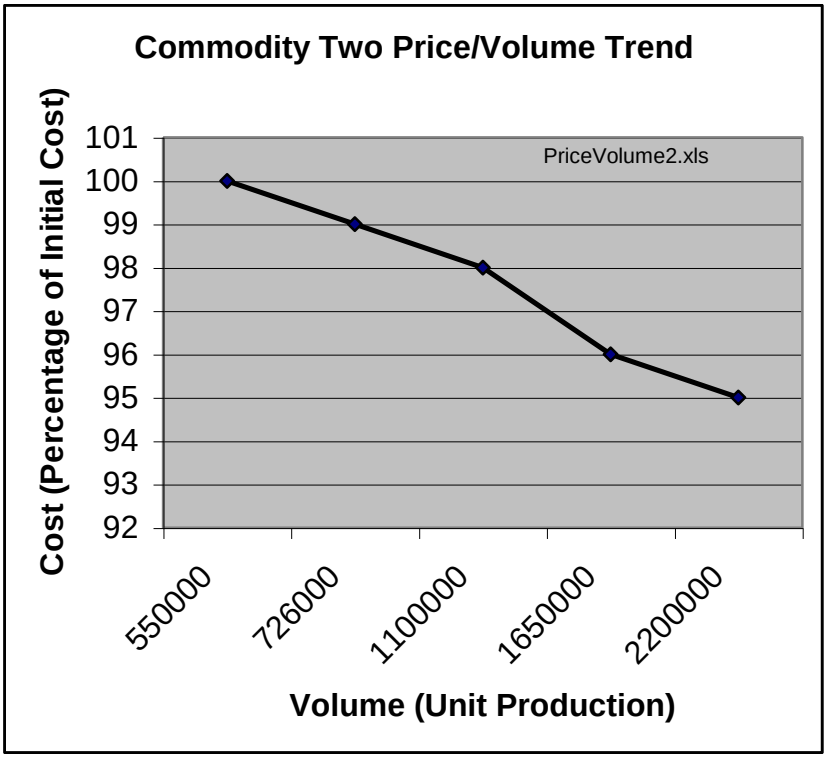

Figure 7.3: Piece Cost/Volume Relationship, Product Two

The price volume trend offered as an example by one of the suppliers involved (Figure 7.3) identified savings of 5% based upon potential volumes which was far short of even the smallest gap of 9%.

Further engineering activity between the respective Ford brands ultimately came up with a combined plan to improve engineering performance of product two with cost reductions of 20% overall.

7.1.1 Summary: Costs

The outcome of both initiatives identified with products One and Two both identified considerable cost opportunities, ones that were agreed by the involved suppliers prior to formal announcement by the team. In all cases, the exercise followed a period of Full Service Supplier involvement, however the savings,

and potential product improvements would not have been achieved without intense pro-activity within the OEM teams.

The success of the activities shown and those by other teams show similar advantages whether the commodities are based upon fuel or any other commodities.

With the limited data presented the outsourcing of intellectual competence to suppliers, in the cases identified, costs were not reduced to a level that is competitive based upon the benchmark cost of the newly introduced competitor supplier. This shortcoming could potentially be due to a lack of willingness or competence. 2**0% cost disadvantage was used as input to the Outsourcing Model** based upon the higher cost Product 2 as identified in Table 7.1.

Table 7.1: Resultant Disadvantage regarding "Costs" associated with the outsourcing of fuel system external expertise.

	Resultant Outsourcing Advantage/Disadvantage
Pre Outsourcing Status	-20%
Outsourced Status	

7.2 Why: Quality

In line with the respondents reasons for outsourcing illustrated by Elmuti et al. (2000) shown in Appendix 5, improved quality is seen as a major advantage gained from outsourcing.

Within the realms of fuel systems, the outsourcing of design, test, development and verification responsibilities provides a further facet of increased responsibility that should be measured to assess the level of any quality improvement. This is a very difficult aspect to measure directly for many reasons. Varying task complexities from programme to programme, increased technical requirements resultant from advanced customer legislative requirements and varying amount of OEM assistance all combine to provide a system that is very difficult to assess for meaningful comparative performance data.

The way this was tackled to provide suitable quality metrics was by selecting a component and associated function often needs a great deal of fine tuning during development to eliminate fuel filling issues. For this purpose, the fuel filler pipe and the associated fuel filling process was selected to provide the benchmark of supplier quality.

7.2.1 Fuel filler pipe design and performance factors

A fuel filler pipe (Figure 7.4) has a simple function in that it is designed to deliver fuel from a filling dispenser gun at a service station forecourt direct to the fuel tank without prematurely stopping or splashing the customer. The fuel filler gun should automatically stop flowing when the rated fuel tank capacity is achieved. There are many different fuel filler gun styles (Ellaflex Ltd, 1988), (Figure 7.5) and geometries that must all be considered.

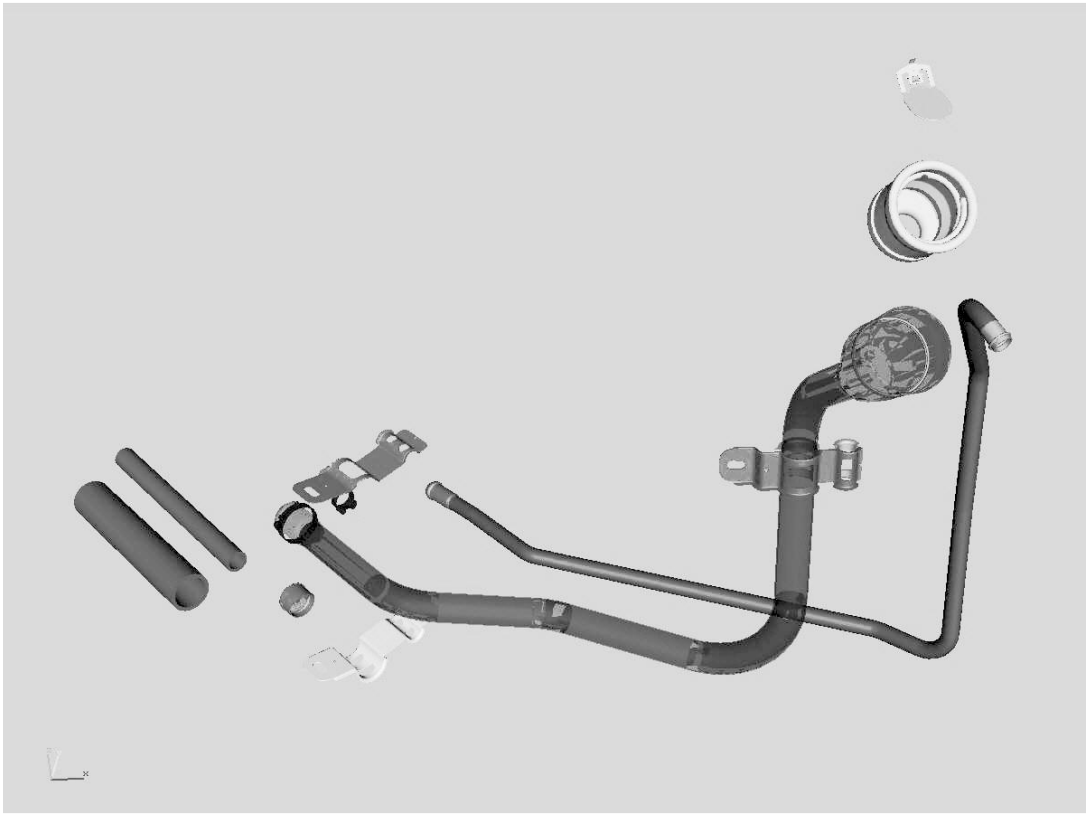

Figure 7.4: Fuel Filler Pipe

Additionally, the flow rates are not standardised and may be set anything between 30 & 60 litres/minute, at the discretion of the service station operators. The end customer will also have the ability to control gun location within the filler pipe aperture or speed of flow by variation of pressure on the gun release leaver. Also, similar designs have to cope with either petrol or diesel fuels that have different formulations from refinery to refinery with various seasonal blends.

All these factors combine to make a high number of potential variable conditions that can significantly alter the quality of the fuel filling experience including severe blow back of fuel over the customer or premature and persistent cut-off of fuel flow.

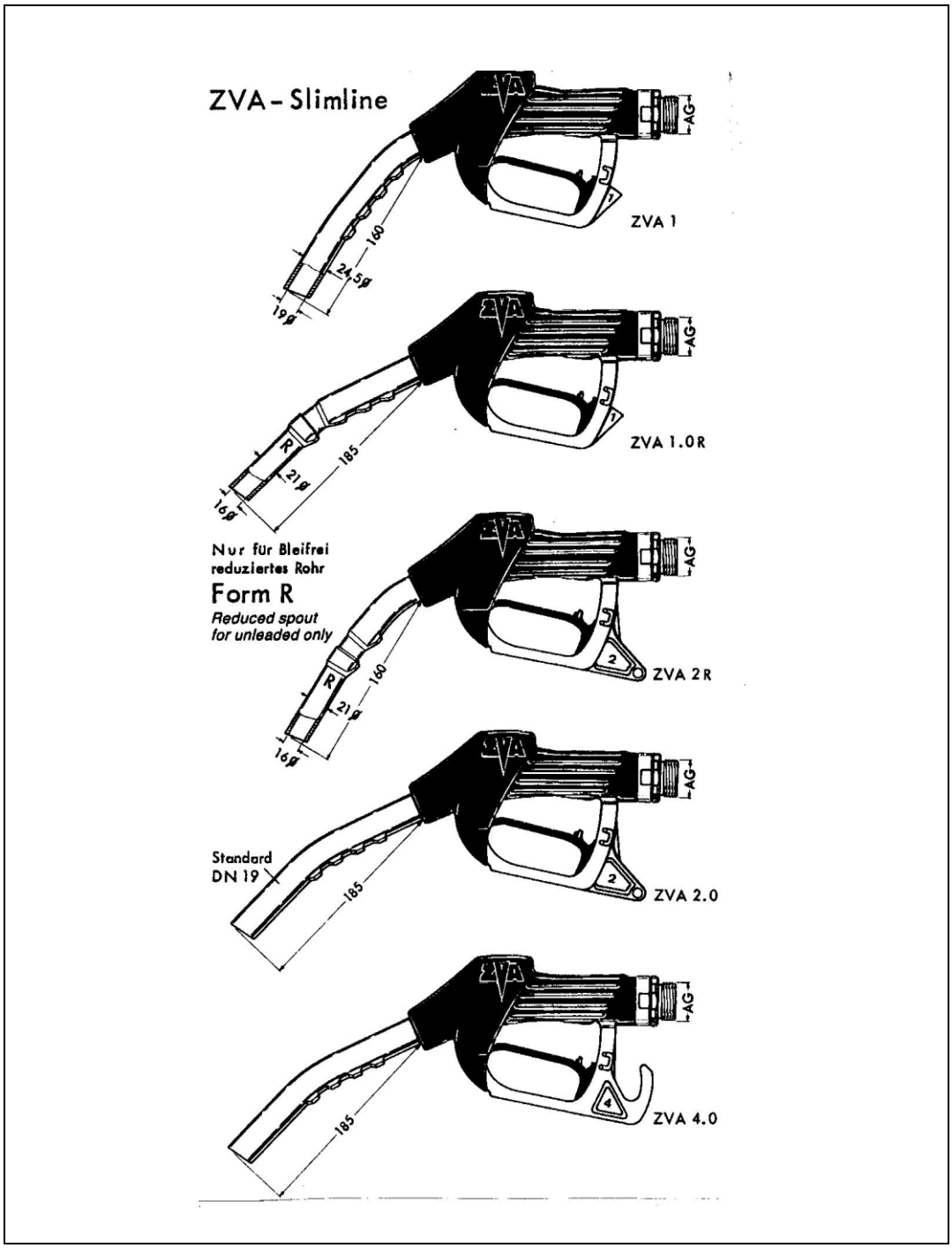

Figure 7.5: A selection of Fuel Filler Guns from the Range of One Manufacturer (Ellaflex Ltd, 1988)

Each programme has to meet strict guidelines in order to meet the various customer and safety requirements associated with the fuel filler pipe system, notwithstanding the specific routing path that must be achieved from a safe

customer friendly filler cap location through the suspension geometry to the tank location. This must be achieved not only for the main fuel feed tube but the smaller diameter sensing tube as well in order to allow displaced gas to vent to the atmosphere.

The fuel filling development task despite being relatively low tech' in its development provides a task that requires much iterative testing that can highlight major differences in overall performance based upon development resources and diligence.

7.2.2 High density polyethylene versus steel filler pipes

An additional facet that will be investigated later in analysing the "Quality" criteria within this case study is the effect of two very different filler pipe manufacturing processes:

Blow moulded High Density Polyethylene (HDPE)

Cold rolled Steel

The blow moulded HDPE filler pipe is a lower cost option used in many earlier products that has slowly been replaced by cold rolled steel variants in order to deliver improvements in other attributes. Whilst the blow moulding process enables much greater flexibility within design/development through the possibility to optimise package space and complex shapes, the manufacturing process can provide significant variability of the wall thickness with resultant changes to internal cross Chapteral profiles, increasing the possibility of fuel filling performance variability.

By contrast the steel tube filler pipes have very precisely controlled internal dimensions but provide greater restriction in adapting to available package space or changes of cross Chapteral form.

7.2.3 Phases of outsourcing and variables to be compared

Quality data from eight car product lines (programmes) within Ford Europe were compared for the assessment. In addition to the comparison of two technologies the assessment also included many other phases of outsourcing that may not be readily apparent. The implementation of outsourcing passes through many incremental phases commencing with the OEM "in-house" competence whereby experienced engineers (experience of at least are vehicle development programme relating to the filler pipe commodity) in control of design and development to a final scenario whereby the OEM experience is low (first programme with this commodity) and totally dependent upon the supplier pool of experience. In between these extremes lies a variety of migration scenarios whereby none of the two extremes are fully represented.

An important factor also considered within the data analysis must also be the amount of "newness" in the filler pipe design i.e. a 100% carryover fuel filler pipe may be expected to perform much better than one that is totally new because sufficient time has elapsed to eliminate all known quality issues.

Summarising the above, (Table 7.2), provides an overview of the individual case study programme combinations used within the quality assessment.

Table 7.2: Combinations of New Filler Pipe Programmes Associated with Engineering Lead and Percentage New Development available for Analysis.

Filler Pipe Technology	Estimated Percentage new development required.	Engineering Lead	Supportive OEM experience, (High/Low)	Programme Designation
Steel	100%	OEM	N/A	1A
Steel	100%	Supplier	High	1B
Steel	100%	Supplier	High	2
Steel	20%	Supplier	Low	3A
Steel	90%	Supplier	Low	5
HDPE	100%	OEM	N/A	3B
HDPE	100%	OEM	N/A	3C
HDPE	0%	Supplier	Low	4

In order to develop a prediction of logical performance ranking, the tabulated combinations were subjected to a Kepner-Tregoe analysis (Table 7.3). The process of comparing quality influential factors associated with each programme combination and apportioning their respective weighting values would provide a ranking of quality potential. It must be pointed out that in the "Filler Pipe Programme" columns, weightings are omitted in programmes that are not associated with individual "Quality Influential Factors". This ranking would be useful in the analysis of actual quality metrics obtained from the Ford computerised Analytical Warranty System.

Table 7.3: Kepner-Tregoe Analysis of Automotive Filler Pipe Programmes and Factors Influencing Fuel Fill Quality.

	Quality Influential Factors									Filler Pipe Programmes							
	Experienced Tier 1	Experienced OEM	Experienced OEM Support	Test Facilities	Steel Filler	Plastic Filler	High % Carryover	Totals		5	4	3C	3B	3A	2	1B	1A
Experienced Tier 1 Lead	1	0	1	1	2	2	1	**8**		8	8			8	8		
Experienced OEM Lead	2	1	1	1	2	2	1	**10**				10	10			10	10
Experienced OEM Support	1	1	1	1	2	2	1	**9**				9	9		9	9	9
Test Facilities	1	1	1	1	2	2	1	**9**		9	9	9	9	9	9	9	9
Steel Filler	0	0	0	0	1	2	1	**4**		4				4	4	4	4
Plastic Filler	0	0	0	0	0	1	0	**1**			1	1	1				
High % Carryover	1	1	1	1	1	2	1	**8**			8			8			
									Totals	**21**	**26**	**29**	**29**	**29**	**30**	**32**	**32**
									Ranking	**5**	**4**	**3**	**3**	**3**	**2**	**1**	**1**
2=Greater advantage,1=Same advantage, 0 lesser advantage														AWSKEPNER.xls			

The Kepner-Tregoe analysis shown in Table 7.3 provides the potential quality influential ranking for each programme based upon the various combinations of technology, carry-over content and supplier/OEM lead and experience. The main purpose of conducting the Kepner-Tregoe analysis is to be able to put resultant quality results into perspective.

Results from the Kepner-Tregoe analysis show equal rankings for some car development programmes. For example programmes 1A & 1B the highest ranked were both led by an experienced OEM team using steel filler pipe technology that could theoretically, based upon the discussion in Chapter 6.2.2, provide improved performance over the HDPE counterpart. The lowest ranked programme is programme 5, a programme with minor carryover content, led by a supplier team and supported by a lower experienced OEM team. The Kepner

Tregoe process was particularly useful in this investigation as it was able to compare and rank filler pipe technology to OEM/Supplier engineering lead which otherwise would be very difficult to compare.

7.2.4 Quality analysis

Using the Ford Analytical Warranty System as described in the Methodology, data was analysed based upon the various progressively evolved phases of outsourcing identified in Table 7.2 and subsequently subjected to the Kepner-Tregoe analysis (Table 7.3). The Analytical Warranty System (AWS) provides a sophisticated database available for comparing Repairs/1000 quality metrics. Additionally it is a system that contains data on vehicle programmes from current date where they were executed totally by suppliers back to programmes covered solely by the OEM. Whilst there are databases that cover other aspects of quality, they are not able to provide data comparisons due to their more recent introduction to Ford. However where other databases can provide data that provides relevance either in strengthening or disputing AWS data they would be used.

7.2.5 Ford analytical warranty system (AWS)

The initial investigation into Ford Motor Company's fuel filling quality concerns was conducted by searching the Analytical Warranty System for metrics associated with the designated fault codes "Slow Fuel Tank Fill/Spit-back". These codes were those entered in Ford's warranty analysis system by the

mechanics in the Ford dealer network. The codes were associated with the customer complaints that need to be rectified. Each claim had its own fault codes associated with it so that concerns could be compartmentalised and matched with associated dealer costs (part and labour). The particular fault code above is one that is always associated with fuel filling i.e. the customer has difficulty in filling the tank at some time in the fuel fill process. With the exception of fuel indication, fuel filling is only fuel system related attribute that has direct first hand customer impact. Typically if fuel filling issues are present they cause the customer much dissatisfaction.

7.2.6 Analysis of high specificity end commodity

An initial investigation of Repairs/1000 where all cases of "slow fuel tank fill/spit-back" where reported provided inconclusive results as it was clear that misreporting had included repaired items that had no direct association with the reported issue. In order to rectify this, a filter was applied within the data that identified repairs including Fuel tank and/or filler pipe (Figure 7.6).
Figure 7.6 provides an indication of some trends. Whilst the OEM led programmes (white traces) are grouped together in the lower order of repairs per thousand, the Supplier lead programmes cover a greater spread including the best and worst results, trace 4 and trace 5.

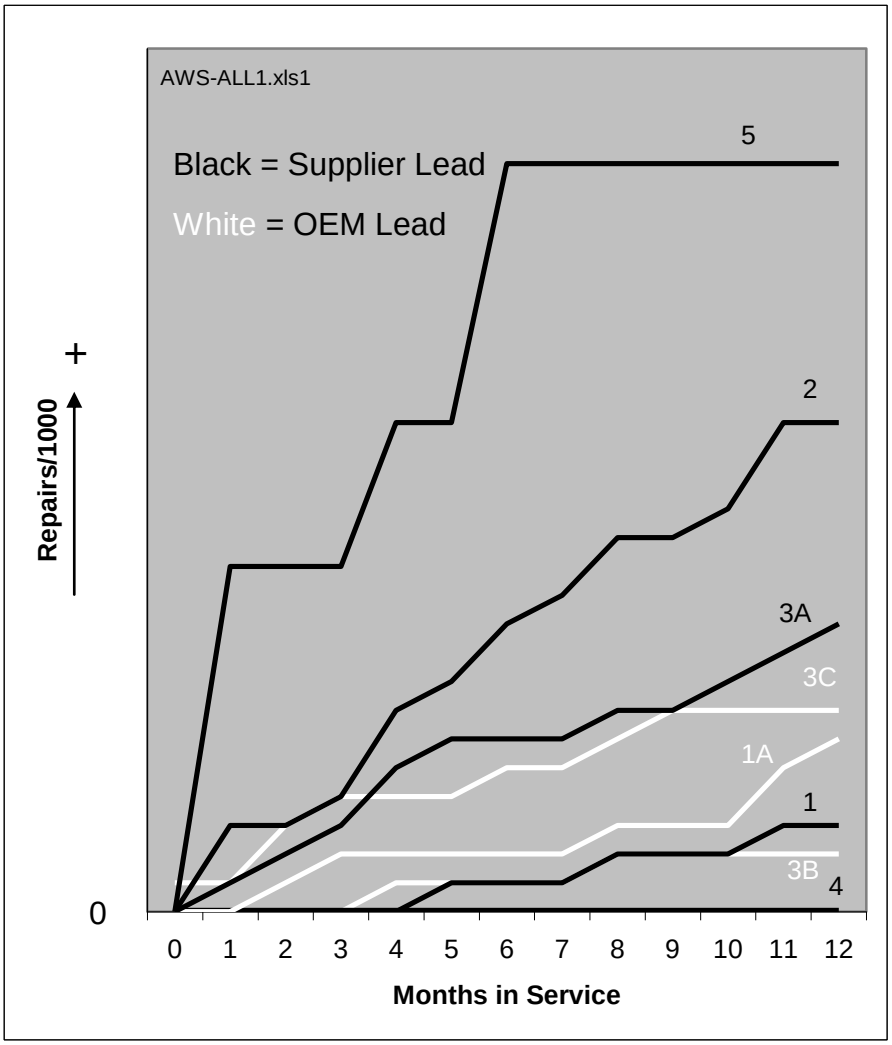

Figure 7.6: Fuel Tank and Filler Pipe repairs due to "Slow Fuel Tank Fill and Spit-back"

A further search was carried out concentrating on the fuel filler pipe and “slow fuel tank fill/spit-back” fault. The resultant search (Figure 7.7) identifying that the filler pipe provided an approximate 70% contribution to fuel concerns in service. Despite the difference in contribution to the fault, the relationships and trends programme to programme are similar in both fuel tank and filler compared to fuel filler pipe only.

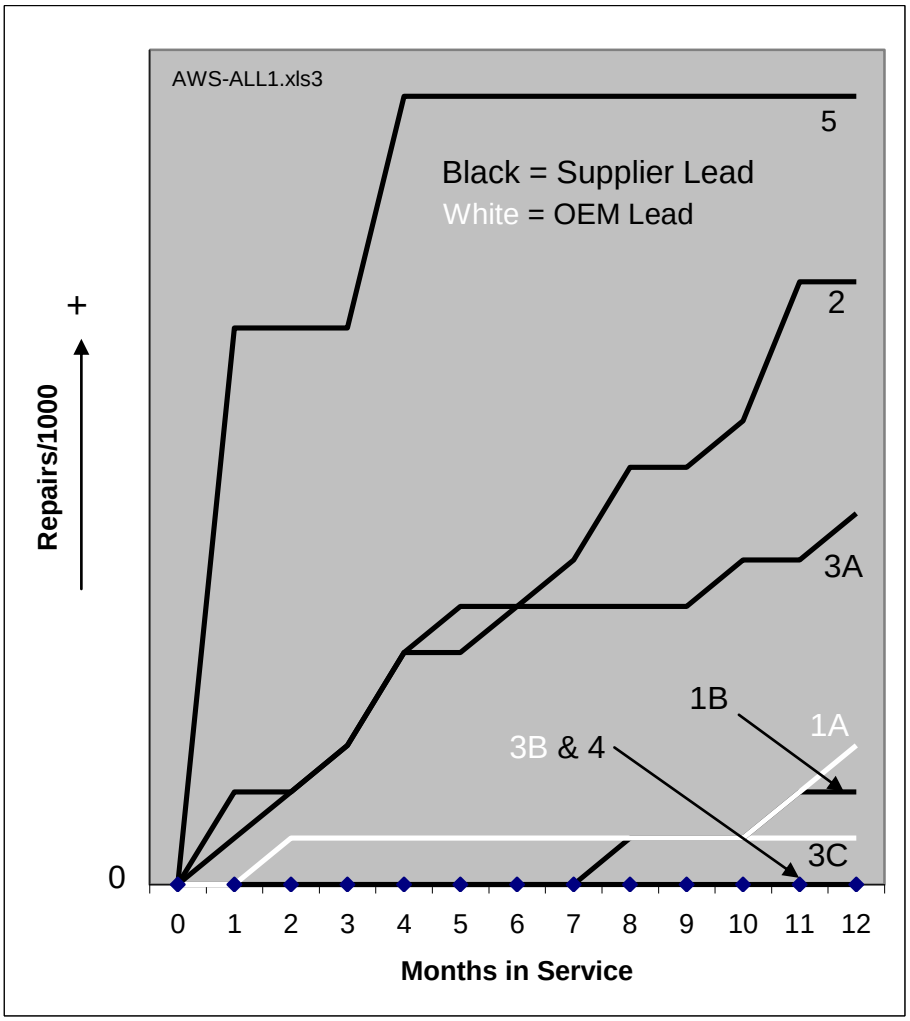

Figure 7.7: Fuel Filler Pipe repairs due to "Slow Fuel Tank Fill/Spit back".

Based upon this similarity, the filler pipe only data (Figure 7.7) was compared with expected performance identified by the Kepner-Tregoe analysis identified in Table 7.3. The result of this, Table 7.4 provides a visual comparison between the two sets of results i.e. expected performance (Kepner-Tregoe) versus actual performance (AWS).

Table 7.4: Comparison of Supplier/OEM Lead Fuel Filler-pipe Programmes Showing Expected Quality Performance Level and Actual Performance Level Ranking. (Programmes Identified in Actual Performance Level Ranking Order)

Filler Pipe Technology	Estimated Percentage of new development required	Engineering Lead	Supportive OEM experience (High/Low)	Programme Designation	Expected Performance Ranking (Kepner-Tregoe)	Actual Performance Ranking (AWS)
HDPE	100%	OEM		3B	3	1
HDPE	0%	Supplier	Low	4	4	1
HDPE	100%	OEM		3C	3	2
Steel	100%	Supplier	High	1B	1	3
Steel	100%	OEM		1A	1	4
Steel	20%	Supplier	Low	3A	3	5
Steel	100%	Supplier	High	2	2	6
Steel	90%	Supplier	Low	5	5	7

Fillerpipe2.xls

A major conflict in expected versus actual quality data was that high density polyethylene (HDPE) filler pipes, whether under a supplier or OEM engineering lead, provided a clear advantage in fuel filling quality compared to their steel counterparts. This was an unexpected result which required further investigation. Whilst the supplier lead HDPE filler pipe (Programme 4) clearly split the performance levels of the two OEM lead programmes (3B & 3C), little can be judged on comparative performance because the supplier lead\programme was almost totally carryover from a previous OEM lead programme. If this result was eliminated, the only supplier lead programme that exceeded an OEM lead

programme was that of designation 1B. This programme was heavily supported by a highly experienced OEM engineer using OEM located facilities for development testing and this scenario was very similar to a total OEM executed programme in that only the test operatives were different. In both cases the test engineers would be subject support from responsible OEM staff.

Following this up by comparing the two suppliers lead steel filler pipe programmes which were supported by highly experienced OEM engineers, from Figure 7.7 it can be seen that there is an approximate 6 to 1 proportional detriment in Repairs/1000 at 12 months with Programme 2 compared to 1B. The main differences between development is that programme 1B was developed at OEM facilities by the supplier who manufactures the filler pipe whereas programme 2 was developed away from the OEM by a supplier who does not manufacture the filler pipe.

As predicted by the Kepner-Tregoe analysis, the weakest quality level resulted from a Supplier led programme with low experienced OEM support despite being tested at the OEM location.

As stated in Chapter 7.2.5, the AWS is a comprehensive warranty data base that provides historic data on various car product lines that sufficiently cover the various levels of outsourcing. A subsequent search of additional metrics using Global Quality Repair System (GQRS) of Things Gone Wrong provided limited data but was sufficient to confirm that programme 1B provided lower quality issues than either 3A or 2 which was in accord with the results already presented.

Based upon this investigation on High Specificity commodity development being led by either Supplier or OEM the following summary was made with respect to fuel filling quality:

1. OEM lead provided highest quality level
2. Supplier lead with experienced OEM support improved quality level
3. Using test facilities close to the OEM and/or allowing the responsible manufacturing supplier to carry out develop provided quality advantage in conjunction with experienced OEM support.
4. Supplier lead with inexperienced OEM support provided lowest quality.
5. High carryover content that requires less development provided greater quality advantage.
6. HDPE filler pipe provide improved quality over their steel counterparts.

7.2.7 Relative supplier/OEM quality performance over time

The indication that within the automotive industry, quality is getting better (Reitzle, 2000) can be reviewed in comparing supplier & OEM performance. Assuming this is the case, the quality performance characteristics measured on a representative spread of supplier and OEM led programmes over a period of years may be optimistically biased towards the more recent Supplier led programmes relating to Fuel Tanks and filling. In order to address this, the fuel tank & filler pipe quality performance was totalled for 11 years of production

(1992-2003). Based upon 12 months accumulated Repairs/1000 for both tank and filler pipe independently.

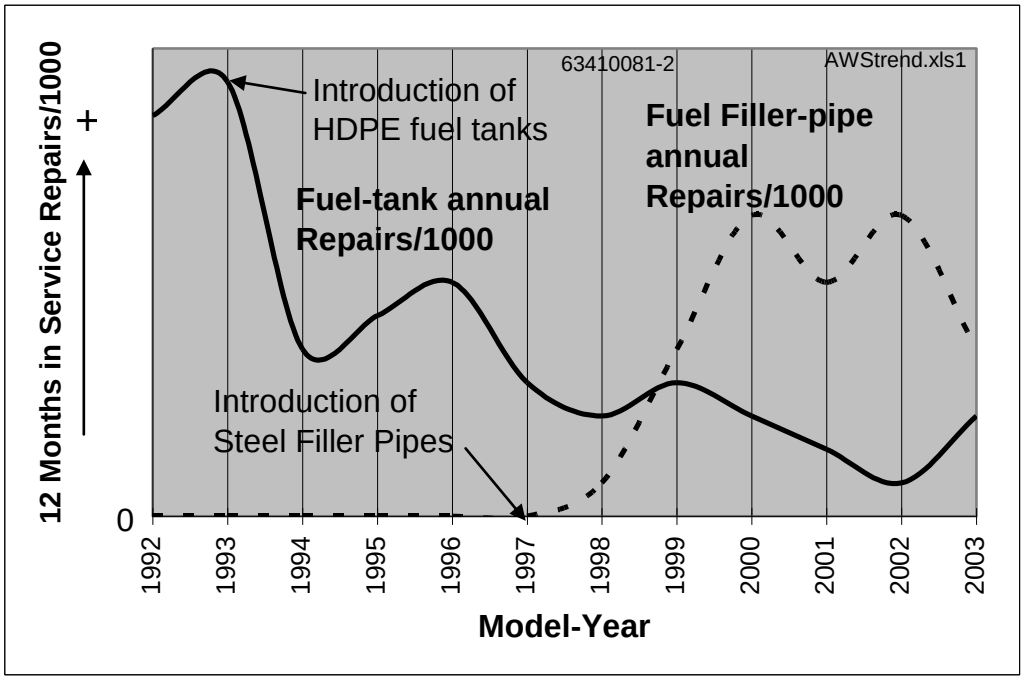

Figure 7.8: Trend line Showing Average Annual Repairs/1000 on Fuel Tanks & Fuel Filler Pipes Related to Fuel Filling Issues for Total Single OEM Population from 1992 through to 2003 Model Years.

Figure 7.8 shows that the fuel tank quality improved markedly in 1993 model-year coincident with the phased introduction of polymeric fuel tanks replacing those previously manufactured from steel. Additionally the fuel filler pipe quality was nominally at zero Repairs/1000 up until 1997 which coincides with the phased introduction of steel filler pipes replacing polymeric filler pipes. Where the estimation was that fuel filler pipes contributed an approximated 70% towards the concern of "Slow fuel tank fill/spit-back" (Figure 7.7), Figure 7.8 indicates this may be true from 1999 but prior to this period the trend was the other way round with fuel tanks providing the major quality issues.

To complete the picture relating to historic progress and improvements in quality the independent graphs of both fuel tank and filler pipe repairs/1000 were plotted alongside the previously shown specific programme repairs/1000 for first year of production after programme launch (Figures 7.9 and 7.10).

7.2.8 Supplier/OEM fuel tank - Time based quality performance

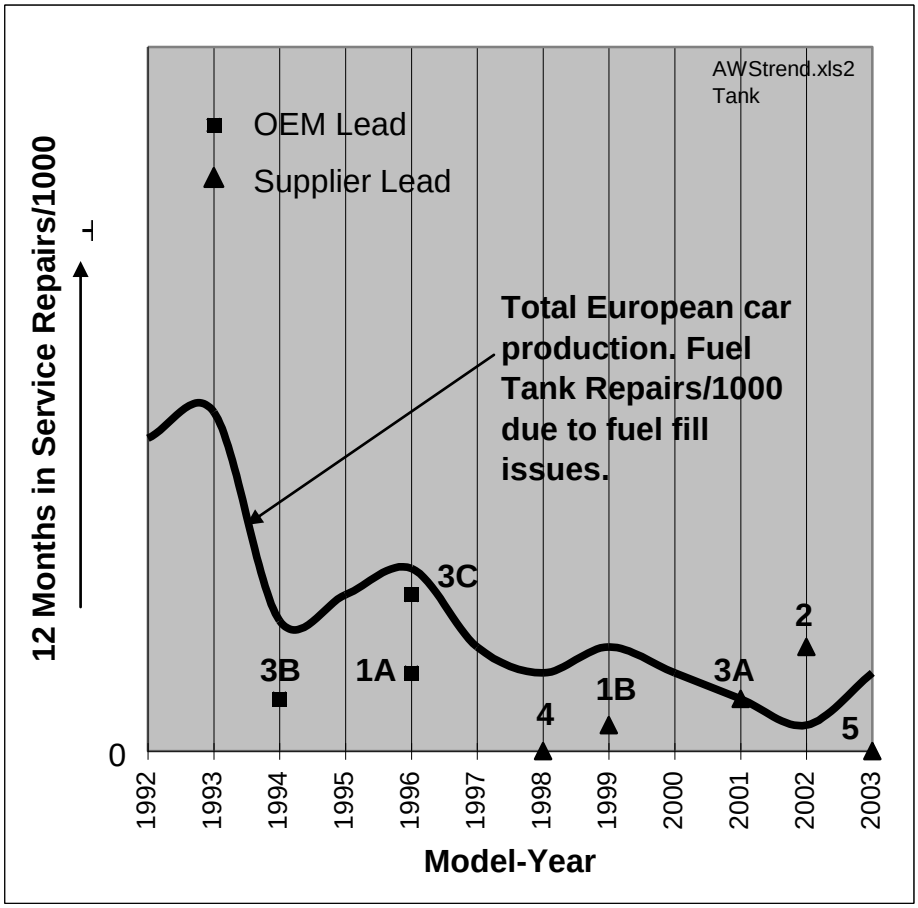

Figure 7.9: Trend line Showing Average Annual Repairs/1000 on Fuel Tanks Related to Fuel Filling Issues for Total Single OEM Population from 1992 Through to 2003 Model-Years with Individual Programme 12 Months in Service Repairs/1000 Shown Individually.

The time based quality improvement (Figure 7.9) shows that improvements have been made in the fuel tank. The first twelve months in service usually represents the worst case and so it is remarkable to see that most programmes were better

than the average of existing programmes. This may have been due to new developments based upon lessons learned from existing programmes, particularly for OEM lead programmes. The only exceptions were the two Supplier led programmes 3A and 2.

7.2.9 Supplier/OEM fuel filler pipe - Time based quality performance

The phased introduction of steel filler pipes in 1997 (Figure 7.10) preceded the introduction of supplier lead programmes by one year. The increased repairs/1000 indicates that the steel filler pipes contributed to the overall decrease in quality from that date. Two supplier lead programmes (4 and 1B) provided higher quality levels (lower repairs/1000) than the general production trend however programme 4 was a programme based upon very minor changes to a previous design. Programmes 3A, 2A and 5 progressively get much worse in quality levels

From the OEM lead programmes, one observes that two programmes (3C and 1A) provided lower quality than the general trend however programme 1A was the first steel filler pipe for Ford in recent history and therefore Ford was new to this alternative technology. Despite being a pilot steel filler pipe programme for Ford, the first 12 months post launch Repairs/1000 were only marginally higher than the first major supplier lead programme, three years later and would comfortably be within the general quality trend following greater progressive introduction of steel filler-pipes.

Programme 3C whilst being outside of the average level zero trend shows much better quality than the two latter programmes 2 and 3.

The phased introduction of steel filler pipes identified by programme 1A (OEM led) slightly precedes the introduction of supplier led programmes which with the exception of programme 4 are all steel filler pipes. One can see that following the OEM led programme (1A), the subsequent supplier led programmes provide lower quality levels as time progresses after programme 1B as OEM support decreases.

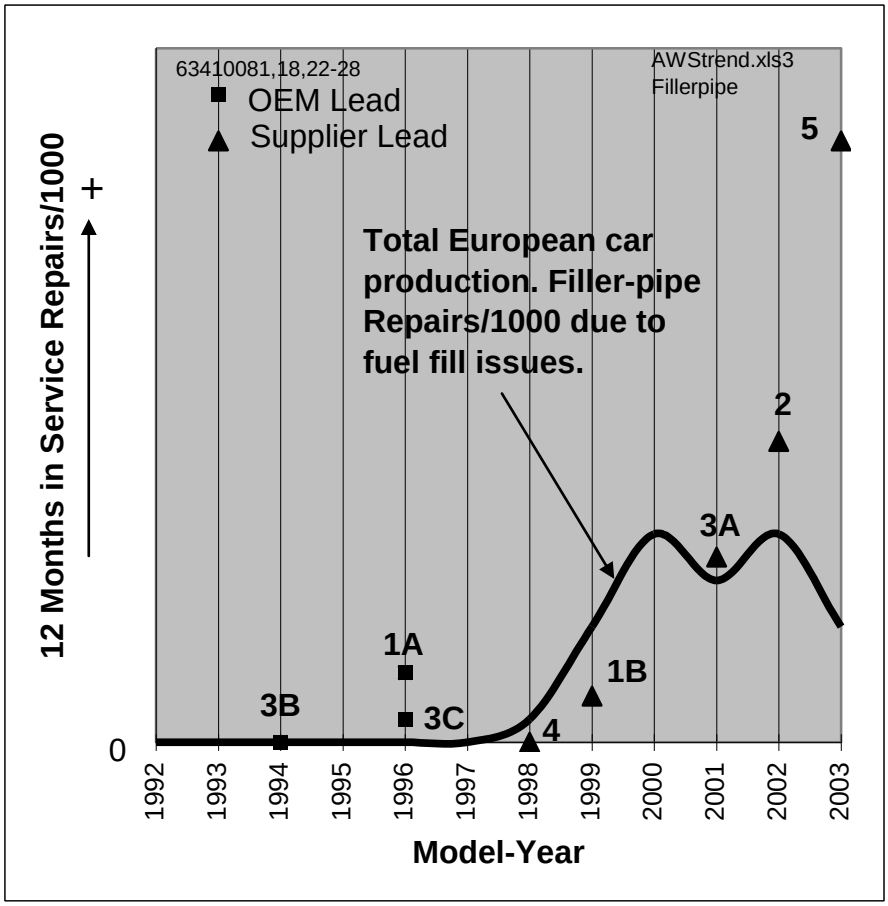

Figure 7.10: Trend line Showing Average Annual Repairs/1000 on Fuel Filler Pipes Related to Fuel Filling Issues for Total Single OEM Population from 1992 Through to 2003 Model-Years with Individual Programme 12 Months in Service Repairs/1000 Shown Individually.

7.2.10 Quality performance after 12 months in service

Within the first 12 months of launch of a new car model, early life failures often occur which are rapidly resolved to ensure that accumulated customer concerns do not deter the overall public perception of the new product's quality level and the response to revised designs should be reflected in the following year's quality levels. An investigation into the subsequent 12 months in service Repairs/1000 (12-24 months after launch) was made to evaluate how an OEM led programme would compare with a supplier led programme. The results, again established by using the Analytical Warranty System are shown in Figure 7.11, from which it is clear that the three OEM led programmes all indicated a resolution of the "Slow fuel tank fill/spit-back" concern description. All three programmes 1A, 4 and 3B reduced to a nominal zero repairs/1000 status.

The supplier performance however was more confused with two programmes, 2 and 3a showing positive improvements and programme 1B that showed good performance in the first 12 months of production then providing deterioration in quality. It may have been significant here that the experienced OEM support was transferred to another programme after the launch of programme 1B leaving the supplier to resolve concerns with more inexperienced individuals.

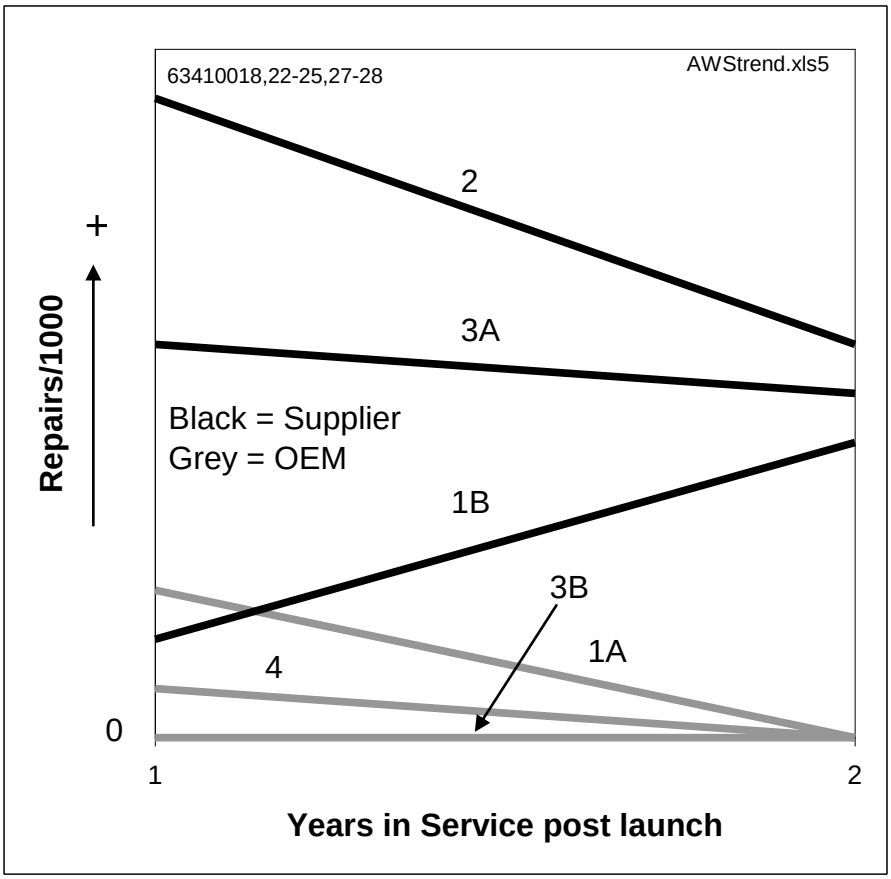

Figure 7.11: Comparison of OEM and Supplier Led Repairs/1000 of Filler Pipes Related to Fuel Filling Issues.

Whilst the rate of quality improvement is clear in both suppliers 2 and 3A the outcome of changes over the second year are far in excess of that of the OEM. The greater quality improvement of Supplier 2 over 3a may be attributed to the fact that experienced OEM support was still available with shared equity in concern resolution for the two years beyond programme launch.

7.2.11 Summary of supplier/OEM quality performance on high specificity end commodity

1. Experienced OEM support appears to be a positive factor in accelerating supplier lead programme concern resolution.

2. Despite identifying some positive efforts by suppliers, the general observation is that supplier lead performance falls behind that of an OEM lead programme based upon a high specificity end commodity.

Whilst different quality metrics have been examined here to ensure they are not conflicting, the one selected for the Outsourcing Model is those based upon Figure 6.7. The Average Repairs/1000 after 12 months in service of OEM lead programmes was a fifth of the Supplier lead programmes. Whilst the calculated deterioration in performance is minus 400%, **the resultant ranking within the model must therefore be minus identified by a 100% decrease in quality levels identified on supplier lead programmes.**

7.3 Why: Technology

In Chapter 6.1, when ascertaining the expertise of the Supplier versus OEM it was established that expertise was almost equal between the two parties. Additionally the investigation into patent activity showed a clear lead in relevant activity of Ford Motor Company related to the individual Tier One Suppliers. Before Full Service Suppliers within fuel systems the relationship was more or less “make to print” but after, the supplier was more empowered to bring on new

technology if it was available and potentially enhance total competence. In order to investigate this, the following relate to two examples of innovation introduced on Ford products.

7.3.1 Example one: Focus fuel filler pipe insert

The first example is an insert, legally required to fit into the filler pipe at its entry point in order to stop diesel fuel filler nozzles being inserted and used in a lead free gasoline fuelled vehicles. This provides added complexity in both manufacturing and final assembly plants. Typical technologies include the insert being mechanically located, usually welded into the filler pipe opening during the manufacture of the filler pipe at the suppliers.
This process has some disadvantages.

1. If the incorrect filler pipe is fitted in the OEM assembly plant, correction is very time consuming.
2. The allocation of a Lead free gasoline filler pipe is defined early in the manufacturing process thereby reducing flexibility to change product mixes required by the OEM at short notice.
3. The early inclusion of the inhibitor within the filler pipe during the supplier's process is not suited to just in time deliveries. Ideally its inclusion should be later in the process to allow maximum flexibility within the process till last minute.

The works of Ricardo et al. (2000) and Alderson (1950) regarding postponement of customisation provided the background theory to improving production processes and hence the basis for a Ford based proposal for the adoption of an insert that could be fitted either at the end of the filler pipe production process or at the assembly plant.

The supplier intention prior to any discussion on this topic was to use conventional fore-mentioned technology. After some meetings initiated by Ford, the suppliers were finally convinced of the potential of such designs and agreed to pursue the introduction of a suitable concept. The net result was that the supplier developed and introduced the inhibitor in line with the proposal with a considerable resultant cost saving.

7.3.2 Example two: Misfueling inhibitor

This example was conceived and introduced during the course of this research and provides a further example of technology led by Ford. It comprises technology that can detect the difference between a diesel and lead-free gasoline fuel filler gun and inhibit discharge of the incorrect fuel into the fuel tank. Its first introduction was on the 2008 model-year Mondeo.

Leading up to this time many suppliers were working on new technology of cap-less fuel systems. In the meantime within the media, there were high numbers reported of customers of many brands misfueling their vehicles (Qureshi, 2007 and Kemp, 2005) which resulted in some patent activity within Ford but no suitable production solution. However, the new cap-less technology being

developed by the enabled the adoption of this inhibition technology. It was uncertain if the suppliers would have considered combining these technologies or even of introducing some form of diesel/gasoline filler gun inhibition without the encouragement of an OEM i.e. Ford and the result was that the suppliers were able to devise appropriate technologies suitable for production.

7.3.3 Summary: Technology

The two examples identified do show benefit from to the collaboration between suppliers and the OEM. Both examples were developed by the suppliers without input from both parties. The work of Momme et al. (2002) and Schrader et al. (1996) related to customer specifications would suggest that it may be unlikely that many companies would push beyond immediate commitments to work out ideas that may benefit the relationship as a whole.

The following points have been identified for specific comments related to the outsourcing model:

- In both cases the OEM, having identified the fundamentals of the new technologies, given adequate resources could have developed them unilaterally.
- In both cases the suppliers did not think about the two technology advances before being presented with them by the OEM.
- Patents were secured by the suppliers which caused inability of the OEM to use common technologies with other suppliers.

The effect on the outsourcing model would be that if all intellectual competency was removed from the OEM, this technology would possibly not have emerged. **The resultant outcome regarding access to technology is viewed as neutral in the outsourcing model.**

7.4 Why: Resources

Resources within the realms of fuel system engineering comprise two main components:

1. Human resources needed to design & engineer the product to a level suitable for mass production and customer usage. This would normally involve a combination of designing products to meet new model package requirements, assessing the designs to ensure they have the capability of meeting corporate and legislative specifications followed by sign-off and confirmation. These tasks fall into the hands of design engineers (draughtsman), component & test engineers.
2. Facilities associated with the delivery of the tasks identified above e.g. draughting facilities (CAD workstations), test facilities and associated office space.

Prior to the Full Service Supplier initiative, the main task of the supplier was to manufacture feasible reliable designs to a given component specification. When things go wrong e.g. a component failed in a durability test it would have been Ford's responsibility to lead the investigation into failure, find a solution and

issue a design change whilst negotiating with suppliers to accommodate the new design and assuring part meets the durability requirement prior to production. Following FSS, Ford was losing many tasks but gaining new ones mainly related to the management of the new arrangement.

The above is an outline of the theoretical situation. In order to substantiate what the real effect in manpower and facilities one would need access to an array of confidential budget data and detailed programme descriptions. In order to provide an indicator of the resultant resource situation, the manpower and facilities will be discussed independently:

7.4.1 Human resources (manpower)

The reasons outlined above identify that there would be some difficulty in obtaining absolute data regarding manning levels associated with FSS. For example, since the introduction of FSS, Ford Motor Company has increased the global production of many products with extra resources being needed to facilitate new suppliers in other parts of the world. This increase may offset any decrease offered by the introduction of FSS. Figure 7.12 shows an indication of the headcount in fuel system engineering and the total chassis draughting/CAE team for the periods 1991 to 2003. Some years are omitted because they were unavailable. The data is based upon organisation plans from the individual years identified. The organisation plans were reviewed with detailed knowledge of individuals and their roles but one must be warned of a potential plus/minus 10% variation indicated on the data shown due to people moving roles within years or covering multiple tasks.

For clarification, the chassis draughting/CAE headcount is a pool of people to support all chassis related work. In reality fuel systems would normally account for about 15% of the identified headcount.

As can be seen from Figure 7.12, there appears to be an increase of fuel system engineers over the transitional period however and without specific and detailed programme/budget details the true situation cannot be assessed accurately.

Likewise with the draftsmen/CAE there has been dramatic change in headcount. The decline in draughtsman at the time of Full Service Supplier activities was dramatic, particularly to detail draughting activities, however the overall packaging of designs into the systems has remained. Along with this remnant there has also been a rapid improvement in CAE analytical techniques

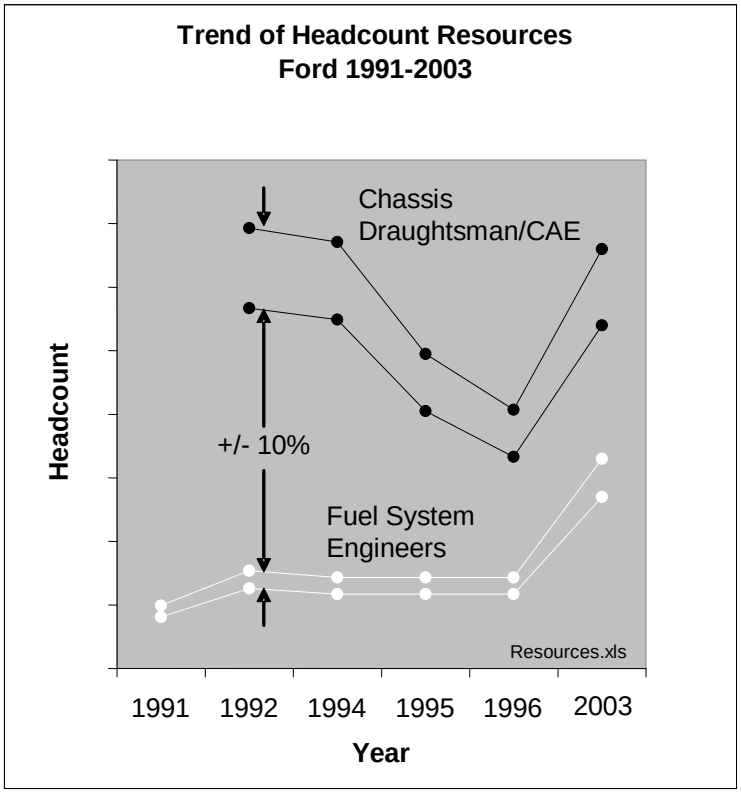

Figure 7.12: Ford Europe Fuel System, Design and Engineering Resource Trend 1991-2003

that enable improved performance in analysis of production feasibility, crash performance etc that have necessitated new headcount. The net balance again requires detailed analysis of confidential budget/programme specific data.
Outside of the manpower requirements already identified, another major effect has been on test personnel; however, because high level vehicle/system testing is still retained within Ford, some capability in the form of facilities and manpower to run them is still required. In the absence of any facilities due to FSS efficiencies, Ford would have to offset the lack of capability by procuring the services externally either through the suppliers or other agencies.

7.4.2 Resources (facilities)

As mentioned in the human resource changes, there has been some change in headcount with a resultant effect on facilities associated with the tasks e.g. CAD workstations. However part of the initiative is supported by Ford supplying facilities for any supplier engineers required to be within a Ford facility. On this basis there must be a great deal of substitution of heads which combined with the 2003 headcount figures identified would provide an assumed increase in the resultant quantity of draughting/CAE facilities.
From the testing point of view, the reduction in Ford in-house facilities was achieved over the period providing a clear and significant reduction in resources. Whilst this shows a clear advantage on paper, any testing still within Ford's responsibility would still have to be procured externally and would provide a negative offset to any advantage achieved.

7.4.3 Summary: Resources

The data provided above provides no clear picture to any accrued resource advantage with the exception of the elimination of the Ford test facilities although here the advantage is unclear unless compared with the external costs that have developed since the elimination.

Clearly, the transfer of major responsibilities to suppliers has resulted in larger dedicated teams within the various supply bases so a combined headcount would be much higher than before outsourcing.

The only clear elimination of resources that has been identified so far is that of the fuel test facilities. Whilst a representative from Ford testing department may clearly state that the FSS initiative clearly provided savings, the overall picture described paints an unclear picture when looked from a wider viewpoint. Figure 7.13 shows the main influential factors discussed.

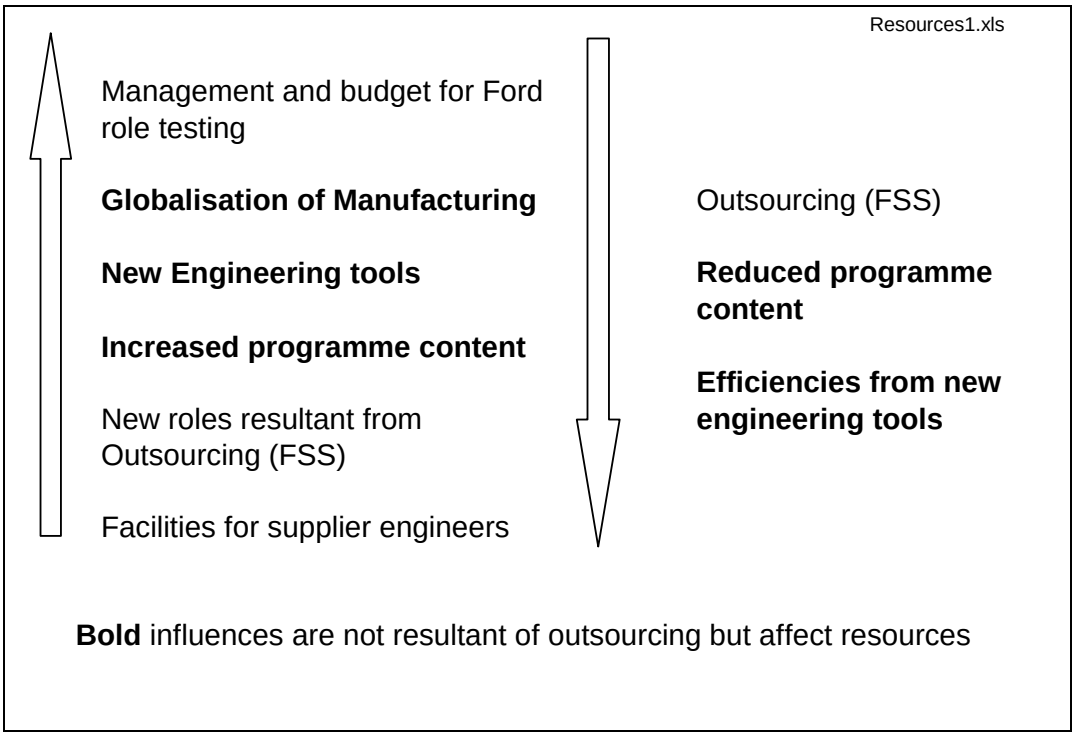

Figure 7.13: Influential Forces Affecting Resources within Ford Fuel System Engineering.

Unfortunately whilst some advantages may be clear, they are not clearly capable of being measured within the availability of data and therefore must be left as an open question and therefore identified as “Neutral” as an outcome in the outsourcing model.

7.5 Why: Capital Funding Rationalisation

The full Service Supplier programme that instigated some actions regarding outsourcing was coincident with further initiatives that passed more of the tool ownership to suppliers of commodities. Costs for tooling would ultimately be recovered as amortization within the piece price (Automotive News, 1999, Ford.com 1999). Similarly with tooling it would be normal practice for any supplier to recover any additive engineering costs necessary to design and develop the new products and again this would have to be within piece cost amortization. It may be that there is some minor advantage if any of the potential savings that may be achieved through reduced resources and associated overheads within the outsourcer exists. If this is the case then it would show up within reduced resources. On this basis this aspect will be excluded within the decision model for this particular case study.

7.6 Why: Competitive Position

The period of Full Service Suppliers for the fuel system included many major regional and global influences that had or are having major effects on the worldwide environment. “The automotive industry worldwide is currently in the midst of wholesale restructuring with continuing consolidation and a fair number

of distressed situations" (PricewaterhouseCoopers, (2005). Like many other companies this has affected Ford Motor Company resultant in a "spin-off" of their electronics division now called Visteon in June 2000 (Visteon, 2000a) and a more recent admission by Bill Ford, following the publicity surrounding the potential merger discussions between General Motors and PSA that anything is on the table for Ford also, (Maynard, 2006). In Ford's homeland in USA, overall US car sales fell one million from 17.7 million in May 2005 to May 2006. This fall in sales was the 12th straight decline for Ford and the fourth in a row for GM (BBC News, 2006).

This distressed state has come about through many factors, many of which are influenced by global factors which are not only hitting OEMs but suppliers also. The filing for Chapter 11 bankruptcy by the massive Delphi organisation; (The Economist, 2005), a major player in fuel systems amongst many other products is a typical high publicity case being observed with interest and followed by many others.

7.6.1 Global influences and effects on the automotive industry

According to PricewaterhouseCoopers (2006), the challenges facing the automotive business relate to higher raw material costs, minimal profit margins, more knowledgeable consumers and new market entrants. The same source also lists the challenges faced by most OEMs in their home markets.

1. Downward pressure on vehicle transaction prices
2. Supplier instability
3. Drive for shareholder value

4. Mounting legacy costs

5. Difficult labour relations

The challenges listed are numerous and whether on an industry or home market scale many of the items are inter-related.

Taking some of these items one at a time, the massive industrial growth within China (Figure 7.14) is not only causing a massive drain on global commodity resources but also providing increased competition within the automotive sector. This has a twofold effect of increasing pressure on established OEMs to reduce prices and effectively increases costs by providing great competition in the purchasing costs associated within the manufacture of the vehicles.

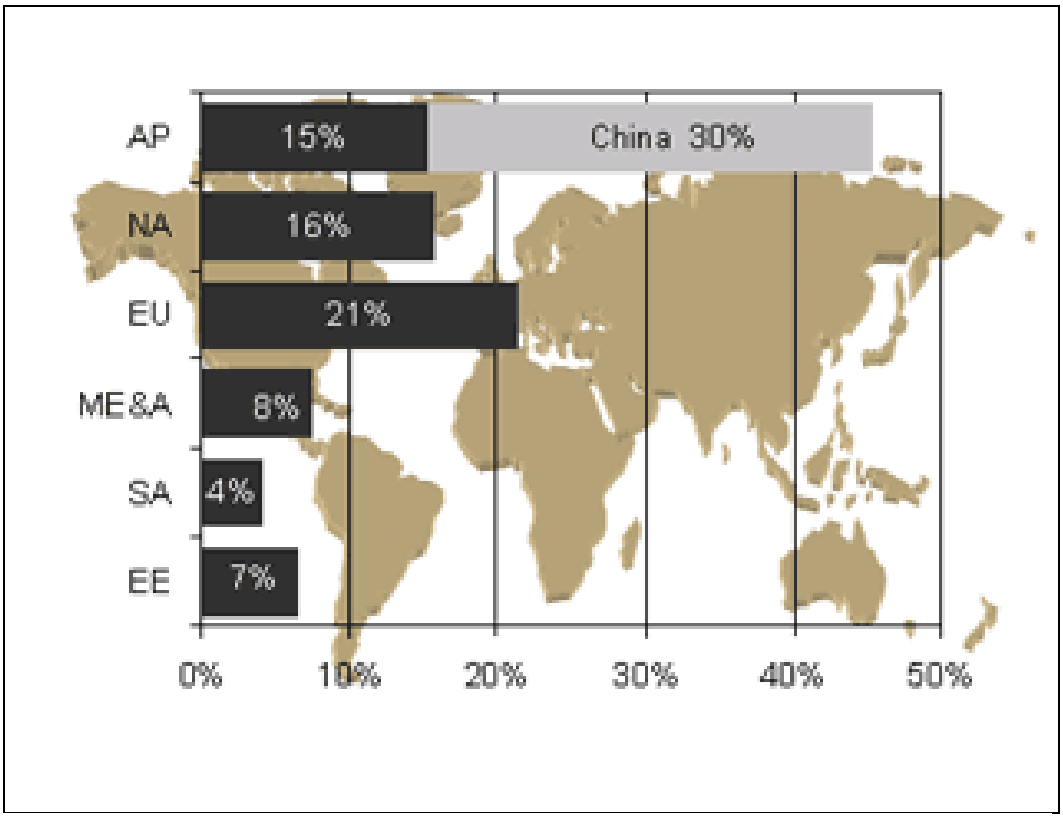

Figure 7.14: Sources of Global Growth (2005-2010)

(PricewaterhouseCoopers, 2006)

Oil price trends over recent years have been turbulent and generally increasing (Figure 7.15). In July 2006 crude oil prices peaked at $77.35 a barrel (Morrison, 2006)

Although this most recent surge was caused by potential hurricane damage in the Gulf of Mexico and potential fears of conflict in Lebanon the chart attached identifies increased demand within Asia as the biggest factor in increased oil prices. These factors do not only affect the business of manufacturing cars, it also affects peoples buying decisions. With increasing fuel costs, customers are more likely to look at buying cars that are more economical to run. Mixed in with this is the effect on customers of increasing global terrorism; (Glasser, 2005) and the worries of global warming; (BBC News, 2006a)

The threat of pension legacy costs is shown clearly in Figure 7.16 whereby more and more established businesses are showing deficits in their financial obligations to retired workers. Supplier Delphi with future pension obligations of $8.5 billion has only $4.2 billion to fund them (The Economist (2005). To put things into perspective General Motors, the largest OEM in the world has legacy costs of $1,525 for health care and $675 for pension costs on every car they sell; (Hammond, 2006).

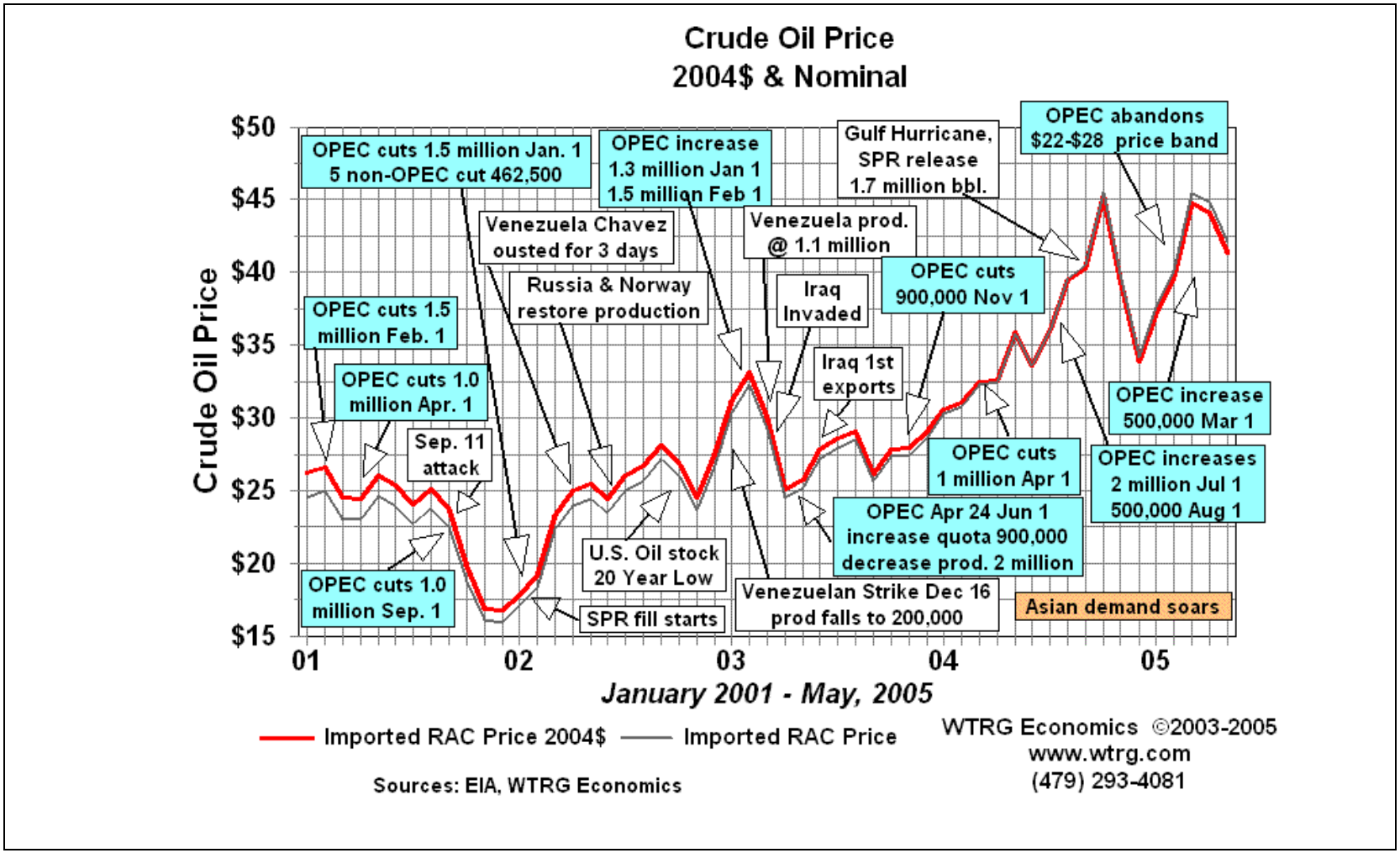

Figure 7.15: World Events and Crude Oil Prices 2001-2005 (WTRG Economics, 2006)

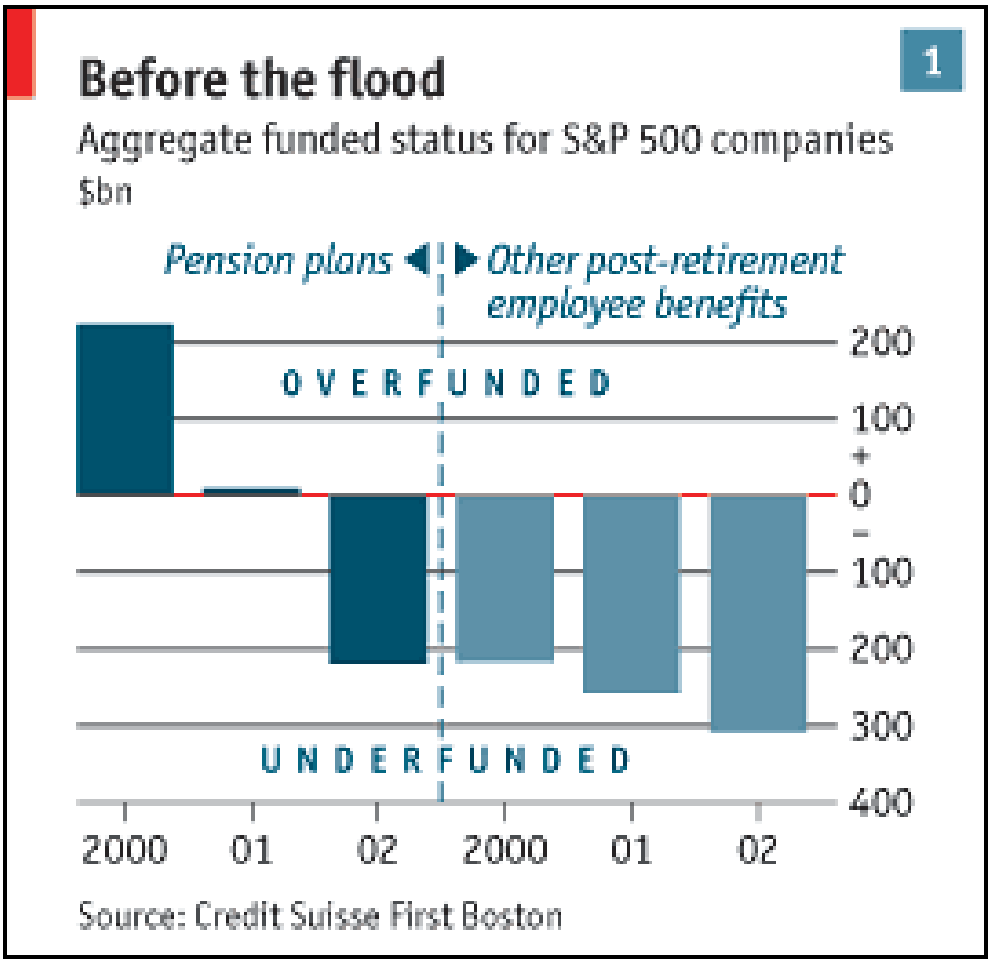

Figure 7.16: The Funding Status of Standard and Poor's Top 500 Companies (The Economist, 2005)

7.6.2 Supplier response

The response by the suppliers within fuel systems is to often follow the lead indicated by Ford Motor Company and other OEMs. Typically all major Tier one suppliers have manufacturing facilities in all the major regions of the world supportive of Ford manufacturing location (Ford Motor Company Ltd, 2006a). The spread of manufacturing bases effectively provide two benefits i.e. providing products for local markets and also allowing OEMs to capitalise on the

low cost country sources in order to compete with the new entrants from these locations and others. Typically of this is that exemplified by the regions occupied by Kautex Textron, a leading fuel system supplier (Figure 7.17).

Figure 7.17: Kautex Textron Sites Worldwide (Kautex, 2007)

The key benefit of course is that the OEMs can source components from varying locations with a degree of confidence that the commodity will be of similar quality to that produced in the developed western countries but at the lower cost afforded by lower wages.

Within the realms of outsourcing, this response of multi-national activity cannot be seen as an advantage afforded by the outsourcing of intellectual competence as once commodity has been developed once in the western world it only needs to be reproduced in other locations with no additional expertise required beyond normal manufacturing competence. It must be assumed some engineering

intellectual competence support would be necessary to support but this would also have been included within any headcount efficiencies already discussed.

Ford's response to customer worries of global warming and escalating fuel costs has been to implement in a £1 billion investment in new technologies related to drastically increasing the economy of diesel and gasoline engines plus development of hybrid technologies; (Booth, 2006). This action, whilst not necessarily effecting fuel system technology to a major degree may ultimately have some effects particularly for example if Ford went 100% to electric cars which could make fuel system competence redundant. The Ford strategy as mentioned whilst including some degree of new hybrid technology would have no major effect on the fore-mentioned Chassis Fuel System.

7.6.3 Summary: Competitive position

The comments and evidence provided related to the outsourcing of intellectual competence within the field of Chassis Fuel Systems provides little advantage in exposure to competitive position in the truly global sense. Both suppliers and OEMs are under similar and related pressures and whilst a supplier may collapse through financial difficulty, the OEM can only respond by re-sourcing or providing financial backing to the failed supplier. In the short term, the only solution would be the latter as even a change of supplier would need a development programme to confirm performance and durability targets are maintained. In conclusion, the resultant input to the case study outsourcing model will be neutral for competitive position.

7.7 Summary: Case Study 2

The completed case study for a high specificity end product (Figure 7.18) shows that no positive benefit has been gained through the outsourcing case presented with an increase in costs and reduction in quality levels. Following the fact that Chapter 6 identified that the outsourcer had greater expertise than the suppliers this final conclusion may have been expected, however final discussion will take place after case study 3 (Chapter 8).

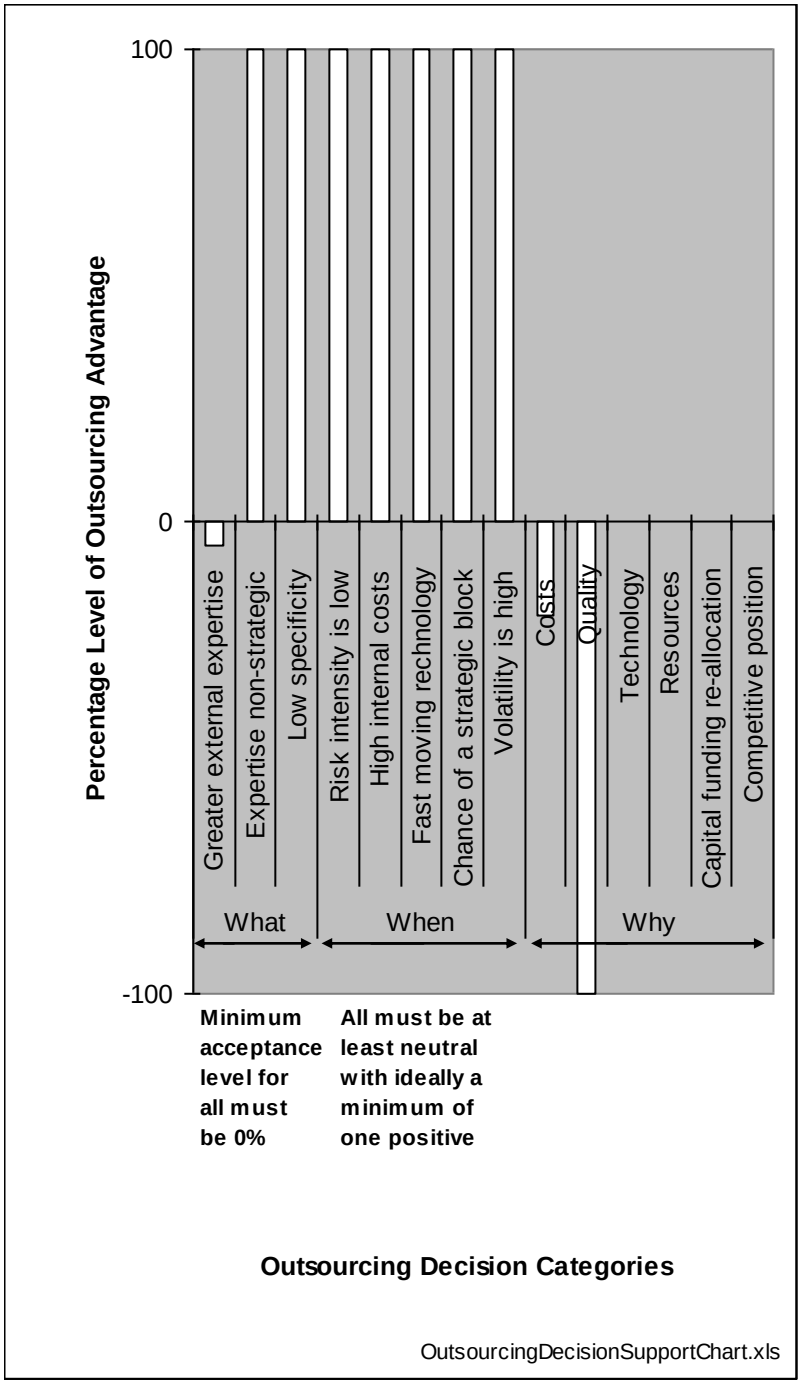

Figure 7.18: Resultant Outsourcing Decision Model Study for Outsourcing of Intellectual Competency Based Upon a High Specificity End Product

Chapter 8: CASE STUDY 3 – OUTSOURCING OF INTELLECTUAL COMPETENCY RELATING TO A LOW SPECIFICITY END COMMODITY

Following similar practice to Chapter 6 and 7, for clarity, Figure 4.4 has again been modified to identify what has been accomplished so far for Case study 3 and what Chapter 8 will be covering.

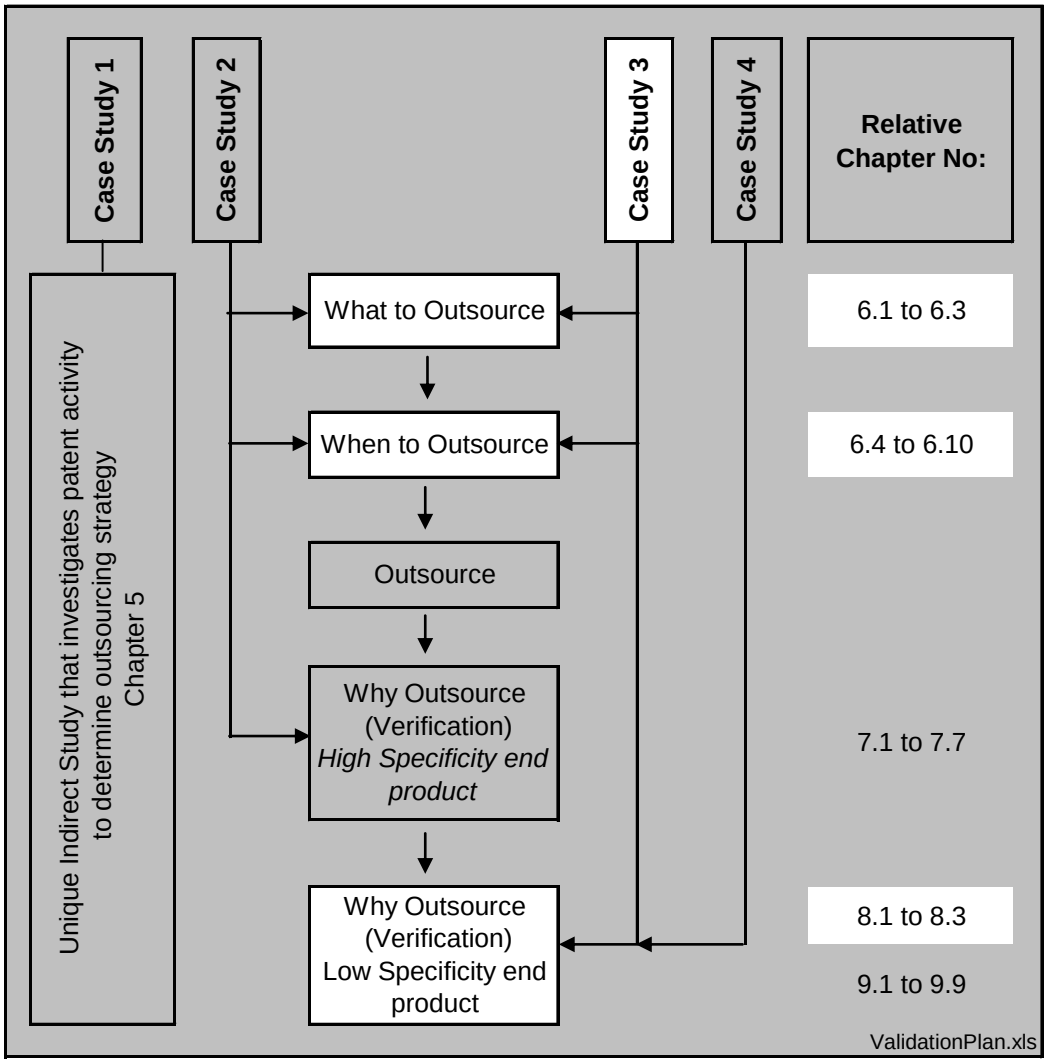

Figure 8.1: Outsourcing Decision Model Validation Plan highlighting what has already been covered in Chapter 6 and what will be covered in Chapter 8 for Case study 3

Similar to selecting the fuel filler pipe and related concern "slow fuel tank fill/spit-back" as a means of comparing available quality data on both OEM and Supplier lead programmes on a high specificity *end commodity*, a similar commodity was selected to provide comparisons for low specificity end commodities. The component selected was a sender unit, an electro-mechanical component that is mounted in the fuel tank to provide an electrical signal to the gauge mounted on the vehicle dashboard to allow the driver to know the level of fuel in available when driving.

As with fuel filling, the fuel level indication system of which the sender unit is a major part is one that has high impact on customers and therefore one that provokes immediate dissatisfaction responses if not meeting customer expectations. Variability within the associated components combined with relative fragility of sender units and that the system represents the efforts of many departmental organisations, both electrical and mechanical also provides an environment for more issues to arise.

The low specificity of the sender unit as a commodity is defined by the fact that although it is a final customised component, built to suit only one application it is however manufactured similar to other competitive parts as a mildly customised combination of generic components used across the automotive industry. Please see Figure 8.2, a typical sender unit.

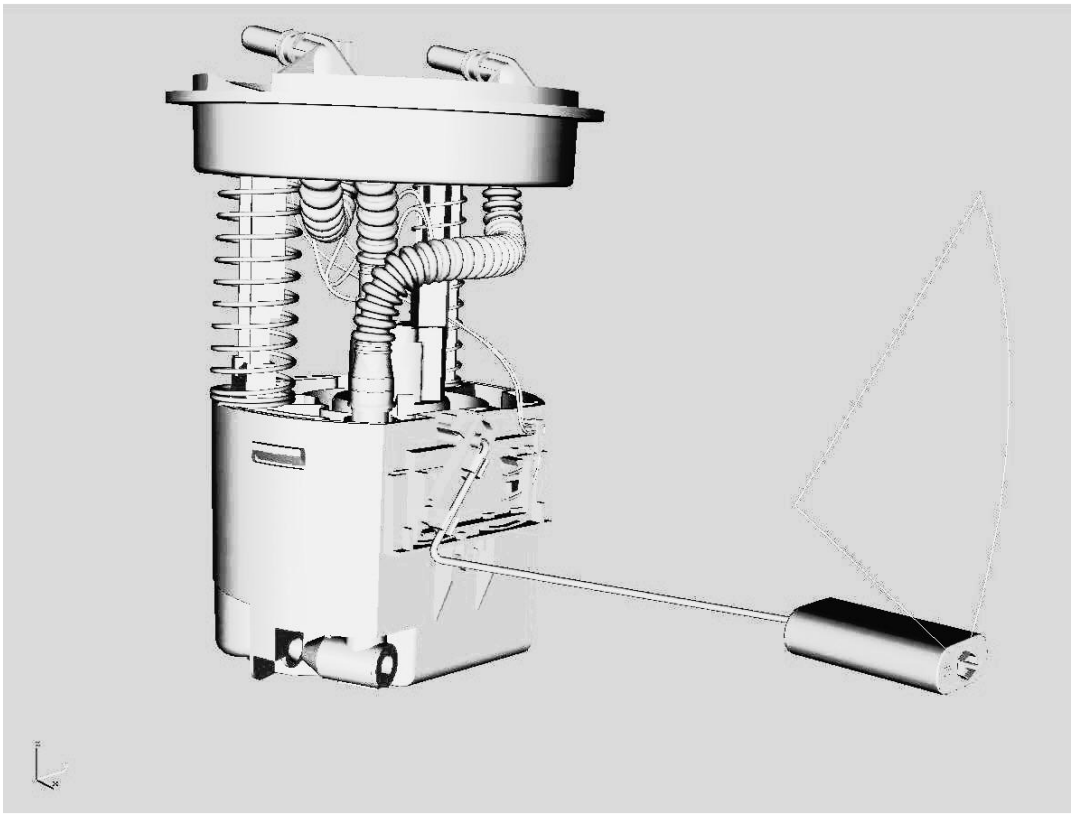

Figure 8.2: Typical Fuel Tank Sender Unit.

Similar again to the high specificity case identified earlier whereby the early life failure concern description used was "Slow fuel tank fill/spit-back", there were similar related descriptions within the Analytical Warranty System related to fuel filling. In the case of the sender unit, the concern description used as part of the AWS database search facility was "Fuel gauge troubles". Again linking this search with appropriate components, in this case the sender unit provided a representation of the quality level of this part and its contribution level to the particular concern.

8.1 Common Fields of Investigation between Case Studies 2 and 3

In order to avoid repetition of work, the following Case Study 3 will use much of the data provided by Case Study 2 where relevant. In most cases, absolute data on individual commodities is confidential and/or confused. In case study one, many inputs were provided based upon generic data with argument to support. On this basis, within the following Case Study 3, the only input that will be investigated to provide a unique input to the outsourcing model will be that for *improved quality* within the *Positive Outcomes?* field.

8.2 Why Outsource: Quality

To lay out the foundation of quality investigation of the sender unit, an initial search was made covering four cases for one year service in each model year from 1992 to 2003 for the total European population of Ford vehicles. Three major searches were included:

1. All indication Repairs/1000 which includes all components that could be included.
2. All sender repair/1000 which would include faults other than "Fuel gauge troubles".
3. Sender Repairs/1000 associated with "Fuel gauge troubles".
4. Fuel Tank Repairs/1000 associated with "Fuel gauge troubles".

The reason for this combination of results was to ensure that the sender unit was a major impact on fuel level indication quality and also to ensure a level of confidence in the AWS system providing data that represented a plausible and acceptable logic i.e. sender units provide a major contribution to fuel indication issues.

Figure 8.3 provides the graphs of data obtained from the initial searches within the database.

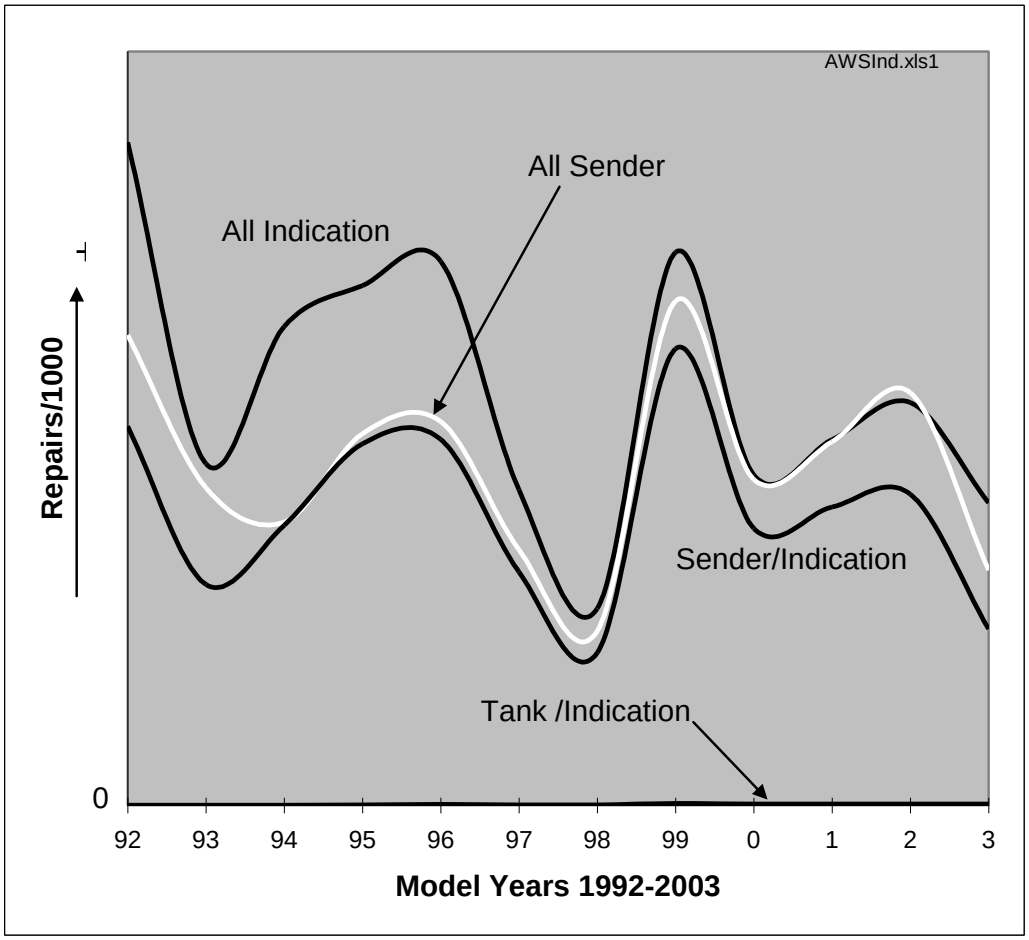

Figure 8.3: Total OEM European Fuel Level Indication Related Repairs/1000 12 Months Post Vehicle Launch.

With the exception of fuel tank related to fuel level indication issues, there was a strong correlation between searches one to three above. Furthermore it appears

that indication issues provide the major contribution to general sender issues and also that sender units are a major contributor to indication issues in general. All this was expected with no surprises; however the sender unit does provide other functions that could have shifted the relative quality levels.

On the basis of the initial search, the plan was set to compare individual supplier and OEM lead programmes quality performance levels on selected programmes

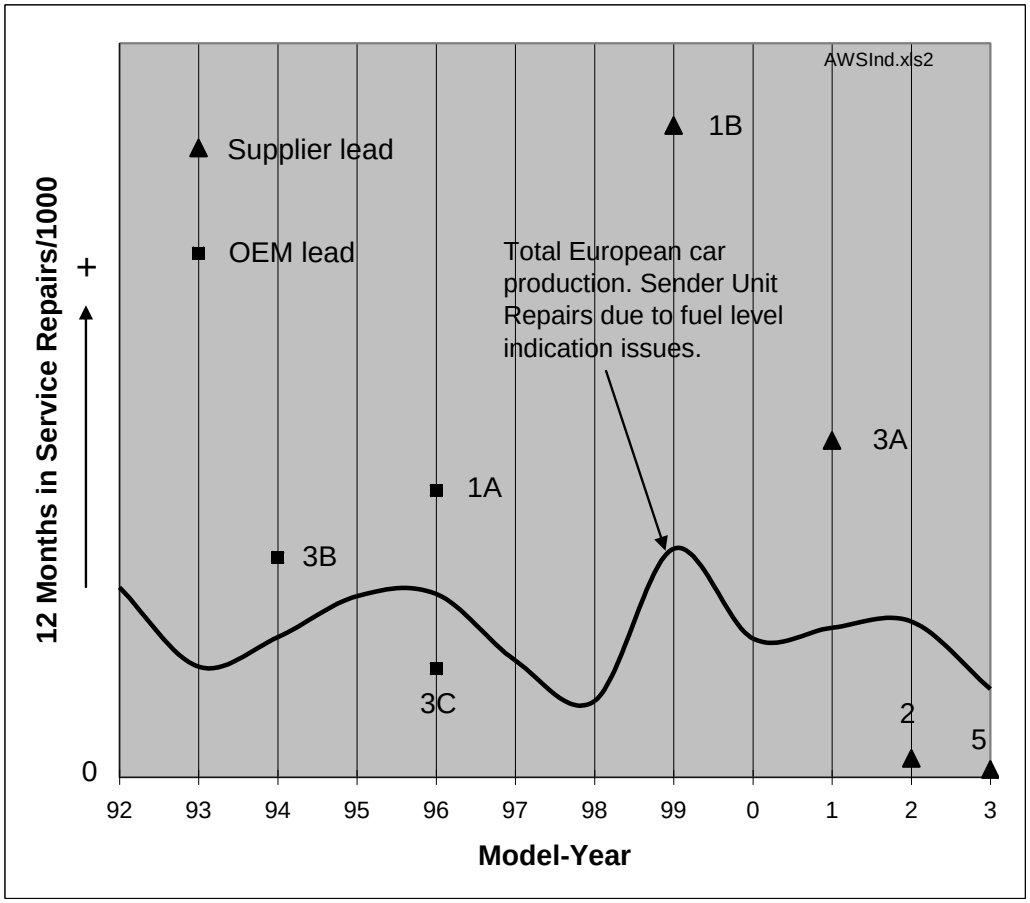

Figure 8.4: Trend-Line Showing OEM Total Production Average Annual Repairs/1000 on Sender Unit Related to Fuel Level Indication Issues from 1992 through to 2003 Model-Years Compared to Equivalent Individual Programme Data

of 12 months accumulated Repairs/1000 after initial launch. The search was based upon the fore-mentioned "Fuel gauge troubles" linked to the sender unit. Once established, these data points were plotted in relationship to the total European Ford population of annual repairs/1000 for the same search criteria. Figure 8.4 provides the results of this task.

The relationship between the OEM and supplier shown in Figure 8.3 is perhaps a little unusual. One could say that the supplier and OEM are the same but in fact that is not true. The situation is that Ford initially had knowledge and design expertise available "in-house" responsible for sender units. This part of the organisation although not within the responsibility of the fuel tank engineering team worked in parallel to engineer a total system. One could say that they were an internal supplier to the fuel tank area however they did also have responsibility for the fuel indication attribute. When Ford divested itself of various competences to an organisation that eventually was known as Visteon, some, but not all employees followed the migration to effectively become an independent supplier thereby taking away the expertise from the parent Ford organisation. The graph above therefore represents a full transition from OEM lead through to independent supplier with many disturbance factors in between associated with new personnel, change of attitudes, re-location of people and establishment of new facilities.

If supplier lead programmes 2 and 5 were ignored it would be easy to assume that supplier lead programmes were definitely not as effective as OEM lead, however the later performance of supplier (programmes 2 and 5) indicate a major shift towards positive performance.

In the cases studied, OEM experience migrated to the supplier and therefore initially after the transition, OEM experience was extremely low and therefore very dependent upon supplier expertise. As time progressed towards programme 2 and 5, one can assume a settling down of the supplier coincident with an increased supportive element of experience from the OEM.

Programme 1B, the worst programme exemplifies the worst theoretical scenario whereby a disrupted team of suppliers perhaps also with some initial motivation issues were working in conjunction with inexperienced OEM engineers to the detriment of quality.

One may also speculate that the increased competitive environment due to separation from the OEM to an external competitive supplier environment may have also helped the Supplier to increase its performance to a greater level than before.

8.2.1 Quality performance after first 12 months in service

The following graph (Figure 8.5) identifies the quality performance from 12 to 24 months after product launch.

You will note that programme 5 is omitted from the graphs due to the non-availability of data. Because the previous graph (Figure 8.4) identified programme 5 as a high performing programme on behalf of the suppliers it is unfortunate that it is not included but one can clearly see that the supplier lead programmes were all positive in the post 12 monthly period. The OEM lead situation was however more inconclusive with two positive quality improvement trends compared to one negative.

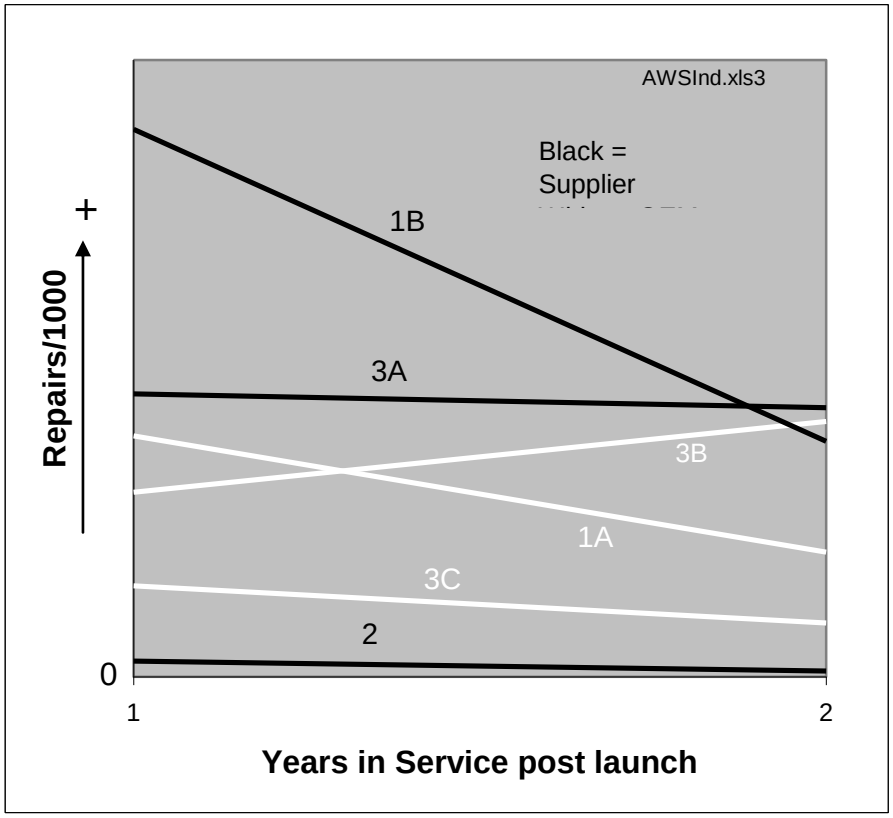

Figure 8.5: Fuel Indication/Sender related Repairs/1000 for 1 & 2 years in service after programme launch

Similar to case study 2, some quality metrics were taken using some of the more comprehensive indicative measures collected. Figure 8.5 was used for the basis of metrics whereby a direct comparison between the average 12 months **Repairs/1000 Supplier lead programme was detrimental to that of the OEM lead programme represented by a 24% decline of quality.**

8.3 Summary: Case Study 3

As illustrated in Figure 8.6 Supplier led programmes based upon the example of Low specificity commodity identified a detriment in performance over OEM lead programmes.

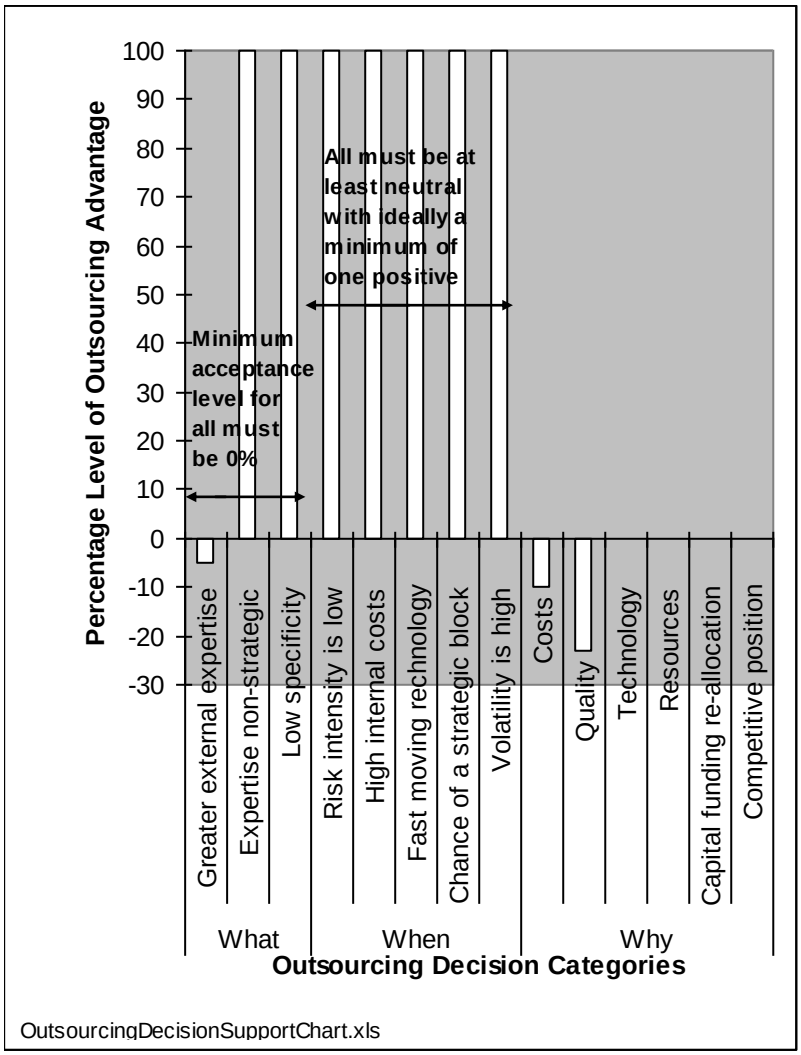

Figure 8.6: Final Completed Outsourcing Decision Model Study for Outsourcing of Intellectual Competency Related to a Low Specificity End Commodity

8.4 Discussion: Case Studies 2, 3 and Outsourcing Model

Within the two case studies provided the resultant evidence does not providing a compelling argument to support the outsourcing of fuel system intellectual competence. Without exception, all Positive Outcomes within the Model were either neutral or negative. If the Outsourcing model was used at the time of the

initiatives in the case studies, theoretically the outsourcing should have not occurred or at least the investigation would promote further investigation. The reduced level of external expertise is an important factor in a complex system involving many vehicle attributes and on balance some detriment in overall performance should have been expected. The additional factor regarding fuel systems strategic expertise was also a key factor that differentiated Ford from its competitors within the research (Case Study 1).

It is timely that whilst this study was in the latter phases Ford published a halting of Full Service Supplier activities (Ford Motor Company Ltd, 2003) accompanied with an additional push to increase competence within the OEM i.e. in-sourcing.

Whilst many of the criteria for outsourcing were met by the Full Service Supplier initiative in the case study, there were many critical factors that were clearly not. The combination of external expertise and whether or not expertise is strategic is very important.

Chapter 9: CASE STUDY 4 – EVALUATION OF THE INTRODUCTION OF A SECOND SUPPLIER INTO A SINGLE SOURCING SITUATION

The three case studies already investigated were provided to validate the developed outsourcing model. Whilst the following Case Study 4 does use key elements of the model it is included to identify if an outsourcing action, once implemented can be developed to provide greater performance advantage to the outsourcer i.e. if after following the decision making process within the researched outsourcing model, the resultant performance is marginal, is there any possibility that performance can be enhanced by a modification to the process? Case Study 4 looks at dual sourcing as a potential means of enhancing performance.

Figure 9.1 identifies what aspects of the outsourcing model will be covered within Case study 4.

Discussion within the research suggesting the link between specificity and commonality provides the basis of the following case study. By reducing specificity in a commodity by definition means that it becomes closer to being generic both within an OEM but also potentially outside as well. Once a commodity becomes generic (low specificity) there is a greater market and potentially more competition within the supply base. At this point it may be advantageous either to single source a commodity in order to obtain greater economies of scale or perhaps consider dual sourcing to increase competitiveness between the selected suppliers.

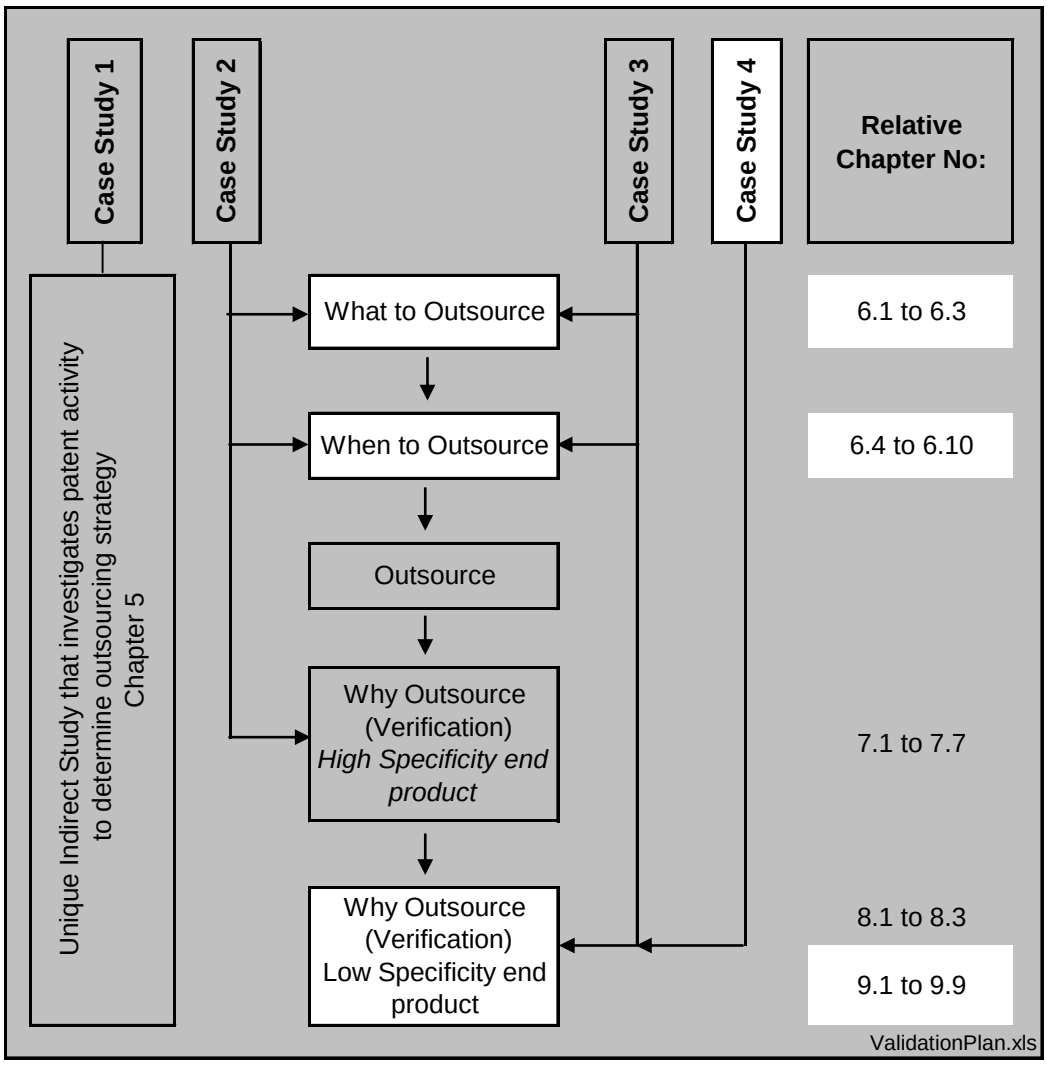

Figure 9.1: Outsourcing Decision Model Validation Plan highlighting what will be covered in Chapter 9 relevant to Case Study 4

The following Case Study 4 provides an insight into a single and dual sourcing situation to identify which is most beneficial for the outsourcer.

The view of Arnold (2000) can be assessed on a low specificity component bought over many years from a known supplier. Whilst the component is a generic component, as in many cases, Ford specifications provide some minor tuning to meet internal specifications and specific vehicle requirements. The case provided identifies the resultant commercial effects relating the addition of

Supplier B2 as a direct competitor to established Supplier A1 who originally supported 100% of Ford European production.

9.1 Description of Outsourced Competency End Commodity

There is a high level of standardisation of the end commodity within the industry with a minor degree of customisation for Ford and a further minor degree of customisation for differing markets and vehicle models. Similar components are made by other competitors but typically are offering slightly different levels of customisation.

9.2 Description of Supplier A1

The Supplier A1 is predominantly based in the USA and is the largest supplier of the commodity within its home base. High standardisation of product aligned with massive production volumes has enabled the company to develop a highly automated manufacturing process providing potential benefits of economies of scale.

The company also has a substantial development capability that has enabled it to develop a highly marketable product that is able to meet the close but diverse requirements of its OEM customers. The supplier is also very proactive and innovative in developing new ideas and concepts that has provided a distinct competitive advantage in recent years.

Historically the supplier served the US automotive home base but in recent years started to market in Europe which further justified a small localised

manufacturing base that providing greater European cost effectiveness through the elimination of significant shipping costs involved with shipping US manufactured components to European automotive manufacturing plants.

9.3 The Supplier's Competitors

In recent years there were four competitors but one was taken over by the fore-mentioned (Supplier A1) at the time of entering the European market. Prior to this takeover Ford successfully operated with two suppliers i.e. Supplier A1 and the company they took over. The takeover of this competitor was the salient factor that caused an immediate elimination of a competitive source within Ford products at that time. The resultant independent European competitors to Supplier A1 are limited and both predominantly Europe based. One (Supplier B1) has very similar capabilities to Supplier A1 and is a leading European Supplier in related products and Supplier B2 is the smaller of the group with limited development facilities but strong commercial relationships with a large OEM.

9.4 Introduction of Additional Supplier B2

Following design reviews, plant visits and various meetings, Supplier B2 was offered Ford business on a moderate production volume vehicle and subsequently became a second supplier.

Based upon standardisation principles and the drive for commonality within Ford, the specifications of the component were enhanced both in performance,

package and customer interface aspects to ensure that the part met a new standard enabling it to be interchanged with Supplier A1 component at short notice with minimal disruption to Ford production. This entailed a greater workload in Ford than normal, not only in defining the new specifications for the component but ensuring the respective model line packaging requirements were compatible and focussed towards commonality. The result provided Ford with a degree of purchasing and engineering freedom it did not previously have with no compromising of quality standards.

9.5 Cost Effects of Introducing Supplier B2

The cost effects of introducing a second supplier are clear to see (Figure 9.2). Result average component costs were lowered ultimately in excess of 18%. Even before quarter seven it can be seen that dialogue between suppliers and OEM had a distinct effect in making Supplier A1 commence reducing costs with the perceived threat of a competitor. Beyond the period of introduction (Quarter 9) further savings were cumulatively made through further efficiencies. To date, the newly introduced supplier is obviously very happy that they have made a foothold as a supplier to Ford albeit a minor foothold. They are also in accord with Ford purchasing in that the new Ford business is seen as commercially advantageous to both parties.

As mentioned earlier the subject component is small but not only that, it represents less than 1% of the sale price of an average car. Assuming a notional cost price of an automobile to be £10,000, an 18% average cost saving on all components could provide a significant cost advantage.

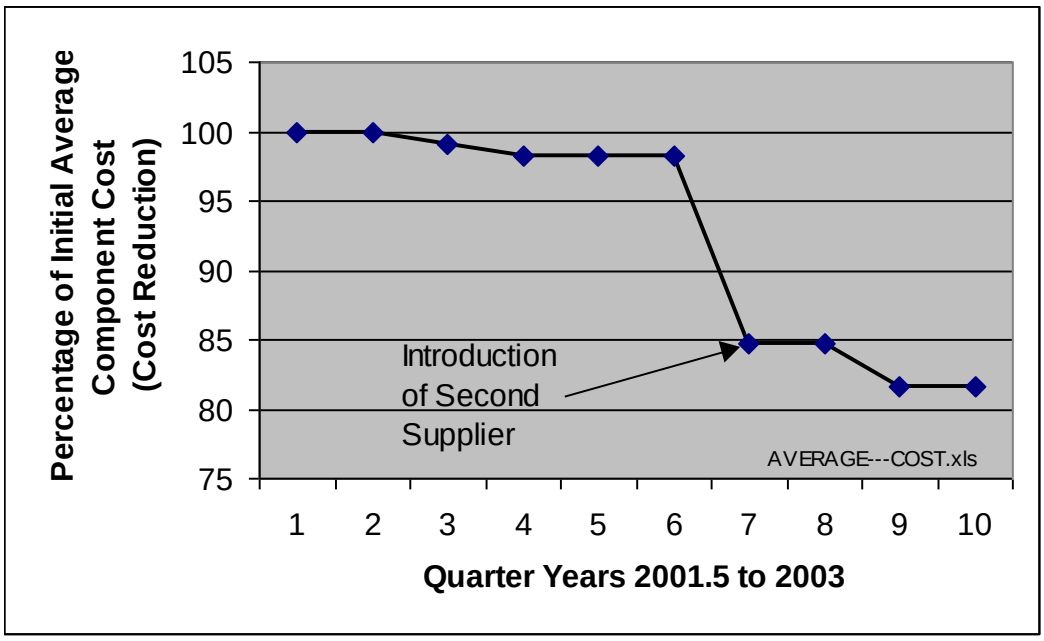

Figure 9.2: Effect of Average Component Cost due to Introduction of Second Supplier.

The resultant effect of introducing a competitor into the business has provided mixed responses by Supplier A1, the original supplier. Of course they see the new supplier as a threat that they would rather not have. Despite this they are confident they can compete and win in the future. This view is similar to the new supplier also. Both suppliers are very confident about their own abilities that both would rather see a fair competitive situation whereby the "best supplier" would be offered 100% of the business. This comment signifies that each are happy with the current benefits of supplying to Ford with the implication that they can provide further individual advantage in becoming more efficient producers than their competitors.

9.6 Effects of Quality

One might assume that a lower cost producer may increase the risk of a detriment in quality level of the bought component. As mentioned earlier, Supplier A1 was already in the process of retooling their component in a more convenient location and thereby providing a rare opportunity to compare quality data on a like for like basis in comparison to their newly adopted competitor. Both suppliers were providing a similar component to their own generic designs with customisation to suit Ford Motor Company specifications with associated new tooling and also introducing them at similar dates in similar markets. Figure 9.3 shows the various performances of the two suppliers within the same model year. The data provided is based upon service warranty claims against the

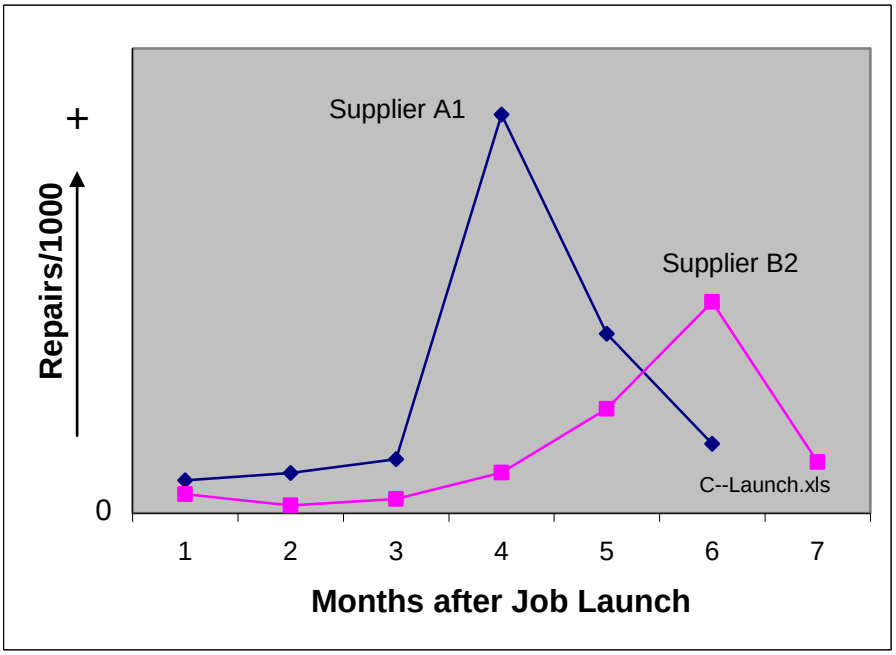

Figure 9.3: Quality Comparison of Existing Supplier A1 & New Supplier B2 in Year of Commodity Launch

actual component. Despite similar start dates, they were not totally co-incident but for the basis of comparison, the data was aligned to provide a direct comparison. Both suppliers performance was marred by early life failures that were rapidly detected and fixed. Within the first model year the established supplier A1 showed inferior performance to the new contender Supplier B2 with a factor of two over the new competitor. The conclusion of first model-years production leaves both suppliers approximately equal.

Figure 9.4 shows the performance of the same two suppliers during the following years production when some stabilisation of quality levels had occurred. Here we see the trends indicated at the year of launch had reversed and show the existing supplier has a twofold quality advantage over the new supplier.

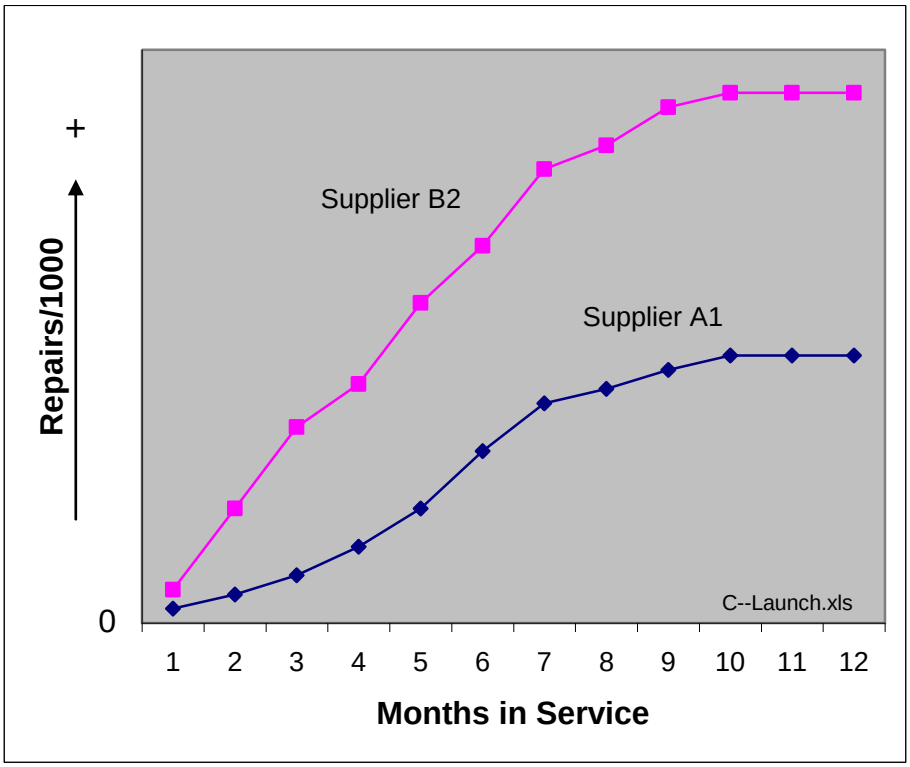

Figure 9.4: Comparison of Existing Supplier A1 & New Supplier B2 in Year Following Commodity Launch.

9.7 Other Tangible Benefits

The previously mentioned commercial benefits are clear but the use of two suppliers also provides an advantage in that potential development resource is increased along with the broader spread of experience gleaned through suppliers of other OEM experiences. The latter, not necessarily through suppliers disclosing competitor secrets but more through improvement of base designs through broader experiences i.e. Ford benefits from other OEMs experiences. There is also the obvious down side to this, whereby Ford competitors may benefit also from Ford experiences.

The development potential has provided direct benefits in that competitive suppliers look at different ways of resolving design issues and broaden the OEM base knowledge. This factor is also evident in that despite standardisation of design, the designs are not the same and respond differently to new unexpected concerns, environments or legislation. Whereas one design may behave badly under a new circumstance and require investment and added function to improve, the alternative supplier's part may show no such issues and need no revision. The outcome is that the supplier of the inferior part cannot automatically resolve the issue and increase prices. The supplier must review himself against his competitor and look at ways to add function without cost. This is purely a case of normal competition.

The dual approach also enables the OEM engineer and buyer to consider supplier cost increases through the ability to consider two contending opinions rather than

one i.e. the OEM has less of a policing role if each supplier is effectively unofficially policing the other.

It may also be that one suppliers component provides greater advantage on a particular model line compared to the competitor due to location, component performance or other reasons and again as with the commercial argument, two suppliers does provide some potential opportunities.

9.8 Negative/Cautionary Issues

In the case cited above, both suppliers are highly competent in manufacturing and engineering their products under the direction of an OEM. Where both lack knowledge or pro-activity is in the area of final customer acceptability of their products i.e. in event of a customer issue (OEM or end customer) the suppliers, in both cases the amount of support needed by Ford is high and variable with the surprising factor to note is that sometimes the supplier with the highest development resource do not necessarily perform to the highest level. Suppliers like OEMs are looking for commercial advantage to maximise profits and this is understandable and normal accepted practice but an OEM must take some safeguards ensuring intellectual property gained through a joint OEM/supplier development does not result in the supplier raising a patent that effectively locks out competition. Within the supplier group discussed there has been speculation that patents applications have effectively halted competition in some aspects to the extent that some suppliers do not even want to compete through fear of legal actions being taken against them. It bears repeating that this is normal business but it is here that an OEM must apply some self-protection through legal

contracts or further actions. The saying "Necessity is the Mother of Invention" is very true; the OEM has direct contact to end customers and is aware of up coming legislation and other effects that may influence design. Additionally the OEM is aware of unique issues posed by carline package issues including the surrounding components and interfaces. The OEM with aligned competence and awareness to these potential issues is in a unique position to assess and raise patents before the supplier is even aware of the issue. Any review of patents indicates that some highly restrictive patents may be raised on very simple ideas often seen as worthless to many engineers.

A final negative issue relating to the above case is that in order to implement standardisation, the task is much easier when utilising one supplier. When co-ordinating the activities of two suppliers, greater effort is necessary to establish the ideal direction for standardisation i.e. what features/dimension to become part of the base design specification. Once this path is established the task gets easier.

9.9 Summary: Case Study 4

It is clear that in the low specificity case identified and the restricted supply base that having two suppliers provides many advantages in cost, technical capability and flexibility. The competitive scenario also reduces the required OEM internal engineering resource but this in turn needs to be redirected to control the standardisation process and provide some form of protective surveillance regarding intellectual property. Overall the case identified provides a win situation for the OEM and generates a healthy competition within the supply

base. This is born out by Toyota who has a long standing two vendor policy that dictates two suppliers for a similar commodity to enable some interaction in quality concerns and knowledge transfer controlled flow of intellect. (Auto Business Ltd, 2002d)

CHAPTER 10: DISCUSSION

The understanding of core and non-core competency of an organisation was found to be the dominant factor in deciding whether to outsource an entity or not. In defining this, expertise and its strategic value provided logical drivers but low specificity, a secondary driver was also clearly identified as a further important factor in ascertaining what to outsource.

Advantages, disadvantages and risks were numerous and as varied as the numerous situations outsourcing can be applied to. This variation really identifies the importance in not only clearly identifying metrics associated with potential gains but also those of where things could be disadvantaged. The importance of establishing good metrics cannot be over emphasised. Without good metrics related to the situation before and after outsourcing it would be impossible to quantify whether or not outsourcing was successful or not.

Whilst the outsourcing decision model was developed to be a single source of information, providing an informed pathway towards an outsourcing decision, clearly the former comment identifies that a high degree of knowledge is necessary to gain and manipulate appropriate organisational data to support the model's successful application.

10.1 Outsourcing Decision Model

A key objective of this research was to provide an outsourcing decision model that required no further research other than gathering the necessary evidence for

individual cases. The finalised outsourcing decision model presented within this thesis (Figure 4.2) meets this objective by providing a summary of relevant criteria with sufficient guidance to ensure a potential outsourcer understands what data to gather in making an informed decision. Within the research process, it was important to focus on the inclusion of only the major criteria for outsourcing. This was important not only for the sake of developing a model that was easily comprehensible but in recognition that each criterion requires a significant amount of data acquisition in order to satisfy an informed outsourcing decision. Whilst more data may provide greater accuracy it also would have the potential of slowing down the process and wasting an outsourcer's resources. In spite of this focus on major criteria, the work necessary in applying to real life would still take a high degree of effort and resource; however, this is justified as the penalty of making an un-informed decision may be unacceptable.

Within the research in Chapter 2, three alternative models were found and subjected to analysis in Chapter 2.12. All, whilst providing similar conciseness to that developed within this thesis, did not have the same flow path approach. Similarly they also did not include the potential metrics and evaluation method. Clarity in operation and guidance through to the decision process and beyond was seen as a key to developing a model that could be used as a practical tool at industry level rather than one that describes outsourcing decision criteria in the form of a research paper. The model presented within this thesis and its supplementary tables provided the necessary clarity and guidance to not only ascertain the criteria necessary in making a correct outsourcing decision but also to understand where and what to gather in the form of suitable metrics necessary to quantify ultimate success or failure.

Whilst the model developed has been designed for display within this thesis, a further enhancement, enabling greater ease of use would be to develop the model into a knowledge based system that not only leads the user through the process in a manner determined by earlier inputs, but one that can also display resultant performance data and comparisons to understand more comprehensively the levels of performance achieved, before and after outsourcing. This process would also inevitably aim to reduce subjectivity within the inputs. Whilst this is a desirable development of the model for business purposes, it was not necessary to develop to this level within the thesis. Ideally, if this was to be achieved it would be through further validation in alternative case studies with operators other than the Author.

Subsequent validation through case studies did not highlight any further necessary changes to the outsourcing decision model presented in Chapter 4. The outsourcing decision model developed and subsequently validated through this research has clearly demonstrated its potential as a practical tool that could be applied at both an industry and academic level. As previously mentioned, whilst a further enhancement could be developed through establishment of a knowledge based system to simplify the process further and eliminate subjectivity, the tool has still demonstrated its usefulness and clarity in focussing upon an appropriate decision.

10.2 Case Study Validation of Outsourcing Decision Model

The validation method selected through case studies provided the most comprehensive coverage feasible without major organisational support.

Whilst a greater number of case studies would undeniably provide a more comprehensive validation of the developed outsourcing decision model, those selected represent the influential environments acting upon on industry (Global, and Industry environments). Additionally the case studies whilst based upon an outsourcing strategy that had already commenced were able to demonstrate a means of assessing the fulfilment of the varying criteria without knowing the eventual outcome, therefore eliminating any potential bias in trying to make the model fit a known outcome. The case studies were comprehensive in their application, accessible regarding necessary detailed knowledge and unbiased towards any final outcome and therefore represent a sound validation of the derived model.

Despite the above comments, there is a minor deviation to the validation plan that would resolve a minor issue regarding the application of the model. Whilst the object was to derive a model that was simple to follow, with no further academic reading necessary, the case studies were all developed by the Author. This was necessary in that the nature of the studies and time involved could only be supported by the Author with minor additional help. To ensure the integrity of the "simple to follow" aspect, ideally the case studies would have been investigated by independent operators, however this was not possible.

Case study 1 in isolation did not provide validation in any shape or form to the developed outsourcing decision model. It was devised as an independent analysis that provided triangulation to strengthen the validation derived through case studies 2 and 3. Within the context of the thesis, case study 1 did indeed strengthen the validation by providing an outcome in accord with both case studies 2 and 3.

The method of using patents in understanding the competitive position within Case Study 1 did provide synergies when comparing levels of expertise within Case Studies 2 and 3 thereby providing greater efficiency within overall research.

10.3 Specificity of End Commodity within Outsourcing

Within case studies 2 and 3, the evidence presented shows very little difference within outcomes regarding whether the end product is high or low specificity. Because the availability of potential case studies enabled the possibility to conduct this minor detour within research it was thought that it may be of interest; however whilst it is clear that specificity is a very important factor relating to what is actually being outsourced, evidence based upon the results of Case Studies 2 and 3 suggest that it is not significant further within associated items already outsourced.

10.4 Benefits of Introducing a Second Supplier into a Single Sourced Supply Situation

Case Study 4 provides a good illustration as to how some of the cost and quality deficiencies identified in Cases Studies 2 and 3 may be remedied. Whether through supplier opportunism or lower expertise, the introduction of a second supplier into a single sourcing situation does provide benefits. Within Case Study 4, both the quality and cost of the existing supplier were improved. To some extent the additional supplier provides the benefit of offering alternative

technical solutions, hence providing some degree of technical governance within both suppliers which is particularly important when capability has been depleted in a given outsourcing organisation. Whilst dual sourcing has advantages, in order to gain major benefit for the outsourcer, the outsourcer would need to maintain some expertise to provide an overview of technology and to act as a mediator in assessing and controlling competitive technologies.

Within Case Study 4, a strict specification for the product was provided to allow total interchange-ability from one supplier to the next with no physical changes within the commodity necessary. This was seen as a very important to assist purchasing leverage. Any relaxing of specification to allow deviation away from interchangeable parts would have diluted the leverage and resultant benefits.

10. 5 The Link Between Specificity, Commonality and Platform Sharing

Chapters 2.14 and 2.15 identify links between Specificity, Commonality and the modern trend of Platform Sharing. Whilst these aspects form a minor part of this Thesis, they have important implications in that there are synergies between outsourcing, platform engineering and commonality. Within Case Study 4, the commodity in question was one specified by Ford. Any supplier could change the design so long as it met the specification. Effectively the two parts were totally interchangeable. On this basis the specificity is related to the knowledge captured within the specification, although the outsourcer would not be too involved in the design of the commodity he would be concerned about its function; however the more a potential outsourcer leans away from specifications, the commodities can become more generic, perhaps using the

same parts as a competitor. Once this has been achieved, effectively the commodity becomes more like a piece of hardware that can be sourced from a multiplicity of suppliers. A generic commodity is one that potentially has a high degree of commonality and therefore lends itself to greater platform sharing. It is clear therefore that within the Case Studies presented, a lesser grip on internal specifications (lower specificity) would have the potential of enabling greater commonality and platform sharing.

Chapter 11: CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

11.1 Conclusions

In order to provide clarity of conclusions aligned to purpose within the thesis, the order of aims and objectives within Chapter 1.2 will be used as the basis for the conclusions presented.

1. The researched generic outsourcing decision model identified in Chapter 4, Figure 4.2 provided a concise decision making tool for outsourcing. In addition, its application as identified in Case Studies 2 and 3 showed that it's application required no additional research necessary to provide guidance in ascertaining the necessary criteria in making an informed outsourcing decision.

It must be pointed out that although the guidance is provided within the model, the ascertaining of relevant criteria and final assessment within any given case must be carried out by individuals with sufficient expertise and responsibility within a potential outsourcing organisation. This factor is important in that many of the metrics require detailed expert analysis that may not be generally available. Typical examples of this are costs and quality data.

2. The approach of triangulating case studies 1 with 2 and 3 identified a clear validation of the outsourcing decision model. This was subsequently further endorsed by the case study outsourcer's action to independently reverse its sourcing decision in line with that identified by the findings of the model application. Effectively, case study 1, case studies 2 and 3 and further literature review relating to the parent case study company provided three independent pieces of evidence in support of the outsourcing decision model.

Case study 1 provided validation by using corporate strategy as a means of comparing the outsourcer used in case studies 2 and 3 with three of its major competitors and case studies 2 and 3 were directly applied to the outsourcing decision model. In all three case studies the evidence was provided that did not support an outsourcing decision.

3. Whilst an outsourced entity should ideally be of low specificity, evidence shown within case studies 2 and 3 identify that specificity was of no significance further down the chain with respect to what product or service the outsourced entity relates.

The conclusion above must be taken in the context of the case studies provided understanding that the conclusion is true as written bearing in mind that the ultimate result of outsourcing within the case studies was negative, both in justification to outsource and resultant performance.

4. Evidence provided by case study 4 identified that performance can be enhanced both within quality and cost advantage through multiple sourcing in a previously single sourced situation. This case study using selected performance elements ("Why Outsource") of the developed outsourcing decision model identifying that the model can also be adapted for other purposes.

Whilst research identified various models relating to the criteria applied to an outsourcing decision, none were usable in their given form to be used as a single entity for the purposes of deciding upon a decision to outsource or not. Each model researched lacked a combination of sufficient breadth of high level criteria or detail necessary to be used without further guidance to a potential outsourcer. The outsourcing model developed within this research was provided in order to provide a working tool to be utilised at industry level without additional guidance or reading necessary to utilise in a real potential outsourcing scenario. Other models uncovered during the research did provide overlaps regarding criteria but were insufficient to use as a workable tool without much extra reading. Effectively in developing the decision model, this research has completed this extra reading and complemented it further by rationalising criteria and providing further metrics.

Case studies 2 and 3 identified that the suppliers had less expertise than the outsourcer. Under normal circumstances, the decision model would have directed a halt in the outsourcing process as it was a key criterion for outsourcing that a potential supplier has greater expertise; however, because the model was

applied retrospectively in the case studies, the outsourcing had already proceeded.

The above comment would have indicated that potentially there would be some detriment in overall performance at a later date after outsourcing and this was the case, both case studies 2 and 3 identified a drop in performance with an increase in costs. The application of the outsourcing decision model in highlighting that the suppliers had lower expertise combined with the resultant drop in performance provided validation of the model in that it uncovered evidence to suggest that this outcome would be likely. If the model was applied and adhered to prior to the outsourcing it is likely that performance would not have reduced.

Case Study 1 also provided confirmation that Ford's approach differed with major competitors as none of the three additional OEMs investigated appeared to be outsourcing their fuel system intellectual competency.

Summarising the above comments, the developed outsourcing model was positively validated in Case Studies 1, 2 and 3.

Case Study 4 identified that both quality and cost improvements are achievable in introducing a second supplier into a single sourcing situation particularly where specificity within the outsourced commodity or service is low. Whilst the research identified this outcome, the reasoning to why this was actually the case was not ascertained. For the purpose of this research, the analysis was sufficient but a deeper understanding would clearly clarify a purchasing strategy that clearly has positive potential.

Whilst the model has been validated addressing one of the major elements within this Thesis, there is clearly still a question in what could be changed within the potential outsourcer/supplier relationship in order to ensure a positive outcome in the strategies described in Case Studies 2 and 3. Supplier expertise was identified as the cause of lower subsequent performance. Further work to understand possibilities to address this by training, collaboration, improved management or some other means would provide a key to a developing a positive outcome in the future.

As can be seen by the case studies provided, it is necessary to gather and analyse much data in order to decide whether or not to outsource. The case studies provided do indicate that the outsourcing model does work but in order fully to verify its greater generic application it would need to be further researched with new cases containing different potential outsourcing scenarios.
The latter work that introduces the link between commonality/standardisation in relationship with specificity is a very interesting subject in its own right and further work that can identify the links to aid an outsourcing scenario would be of great interest offering much potential for industry.

5. Through literature review (Chapter 2.13 and 2.14) a link between Specificity, Commonality and Platform Sharing was identified which further lends itself towards platform engineering. It follows therefore that by re-engineering to decrease specificity in a commodity provides a positive edge to provide more competiveness through commonality. In

addition the reduction in specificity also increases the scope for further outsourcing.

6. Patent activity within an organisation can provide a means of indicating corporate strategy relating to particular entities.

Within Case Study 1, without the direct knowledge of particular OEMs outsourcing strategy with regard to a particular entity an alternative method was adopted to establish this by comparing patent activity as a measure of innovation with high level corporate statements. These comparisons provided good correlation and provided high confidence understanding of each OEM's strategies identifying that they both could be used as independent means if necessary. This work, adapted from the work of Pakes et al (1984) and Liker et al (1996) particularly strengthens the statements of the latter. Based upon the work of Parasuramen et al (1983), Franko (1989) and Morbey (1989), whilst Research and Development budget could also have been used as another means of establishing the strategy, it could not be applied in this case as the R&D budget of these companies could not be broken down to ascertain the budget for particular entities.

11.2 Recommendations for Further Research

Comments within Chapter 10 provide the basis of further research that could enhance that already covered within this thesis. In principal this comes down to two aspects;

1. Develop the outsourcing decision model into a knowledge based system in the form of a computer based questionnaire that leads the operator through the process, providing necessary guidance at appropriate times in a direction provided by answers already provided by the operator. This programme whilst reducing subjectivity would also, clearly identify the key metrics that support a decision and provide guidance into identifying appropriate metrics to monitor after outsourcing.
2. Apply case studies to the outsourcing model using various individuals in order to uncover any areas where greater clarity in process direction may be required.

Whilst both the above further developments would be useful, from the perspective of this thesis, the research is complete in that the model has been developed to a clear working level and validated through comprehensive case studies.

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APPENDICES

Appendix 1: Assessing the Dynamics of the Environment (Ansoff et al. 1990)

Appendix 2 : The industry life cycle and its strategy implications – a conventional view (Lynch, 1997)

Appendix 3: Outsourcing definitions (Baines et al. 2000)

Appendix 4: Drivers for Outsourcing (Beulen et al. 1994)

Appendix 5: Reasons for global outsourcing as perceived by survey Respondents (Elmuti et al. 2000)

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Assessing the dynamics of the environment

	Environmental turbulence	*Repetitive*	*Expanding*	*Changing*	*Discontinuous*	*Surprising*
Changeability	*Complexity*	National	National	Regional Technological	Regional Socio-political	Global Economic
	Familiarity of events	Familiar	Extrapolable		Discontinuous Familiar	Discontinuous Novel
Predictability	*Rapidity of change*	Slower than response		Comparable to response		Faster than response
	Visibility of future	Recurring	Forecastable	Predictable	Partially predictable	Unpredictable surprises
	Turbulence level	**Low 1**	**2**	**3**	**4**	**5 High**

Dynamicsofenvironment.xls

Appendix 1: Assessing the Dynamics of the Environment (Ansoff et al. 1990)

	Introduction Phase	Growth Phase	Maturity Phase	Decline Phase
Customer Strategy	• Early customers may experiment with product and will accept some unreliability • Need to explain nature of innovation	• Growing group of customers • Quality and reliability important for growth	• Mass market • Little new trial of product or service • Brand switching	• Know the product well • Select on the basis of price rather than innovation
Research and Development Strategy	• High	• Seek extensions before competition	• Low	•
Company Strategy	• Seek to dominate market • Research and Development & production particularly important to ensure product quality	• React to competition with marketing expenditure and initiatives	• Expensive to increase market share if not already market leader • Seek cost reductions	• Cost control particularly important
Impact on profitability	• High price, but probably making a loss due to investment in new category	• Profits should emerge here but prices may well decline as competitors enter market.	• Profits under pressure from need for continuing investment coupled with continued distributor and competitive pressure	• Price competition and low growth may lead to losses or need to cut costs drastically to maintain profitability.
Competitor strategy	• Keen interest in new category • Attempt to replicate new product	• Market entry (if not before) • Attempt to innovate and invest in category	• Competition largely on advertising and quality • Lower product differentiation. • Lower product change	• Competition based primarily on price • Some companies may seek to exit the industry

Appendix 2 : The industry life cycle and its strategy implications – a conventional view (Lynch, 1997)

Author		*Definition of Outsourcing*
Hiemstra & van Tilberg, 1993 quoted by Fill & Visser (2000)		"subcontracting custom-made articles and constructions, such as components, sub-assemblies, final products, adaptations and/or services to another company"
Kepler & Jones, 1997 quoted by Waterson et al. (1999)		"contracting out certain manufacturing processes and sub-processes to other companies (rather than making everything in-house)
Gordon and Gordon (1996)		"to contact out certain peripheral functions of core business to companies specialising in that particular field
Antonucci et al. (1998)		"IT outsourcing is defined as contracting with outside vendors to do various IT functions such as data entry, data centre operations, application maintenance and development, disaster recovery and network management and operations"
Greaver (1998)		"is the act of transferring some of the company's recurring internal activities and decisions to outside providers, as set forth in a contract"
Lankford & Parsa, (1999)		"the procurement of products or services from sources that are external to the organisation"
Ettore, (1999)		"is subcontracting a piece of business outside the company"
Mariotti, (1999)		" a strategic decision to obtain goods or services from independent organisations outside of a company's legal boundaries; to purchase goods or services instead of making or doing them"
Lonsdale & Cox, (1998)		"the process of transferring an existing business activity, including the relevant assets, to a third party"

Appendix 3: Outsourcing definitions (Baines et al. 2000)

Quality	Actual capacity is temporarily insufficient to comply with demand. The quality motive can be subdivided into three aspects: increased quality demands, shortage of qualified personnel. Outsourcing as a transition period.
Cost	Outsourcing is a possible solution to control increasing costs and is compatible with a cost leadership strategy. By controlling and decreasing costs a company can increase its competitive position.
Finance	A company has a limited investment budget; The funds must be used for investments in core business activities, which are long-term decisions.
Core Business	Core business is a primary activity with which an organisation generates revenues. To concentrate on core business activities is a strategic decision. All subsequent activities are mainly supportive and should be outsourced.
Cooperation	Cooperation between companies can lead to conflict those activities that are produced by both organisations should be subject to total outsourcing

Appendix 4: Drivers for Outsourcing (Beulen et al. 1994)

Rank	Factor	No of respondents
1	Cost reduction	156
2	Quality Improvement	152
3	Increase exposure to worldwide technology	150
4	Delivery and reliability improvements	148
5	Use resources that are not available internally (e.g. inability to hire employees)	136
6	Gain access to materials only available abroad	122
7	Establish a presence in a foreign market	104
8	Maintain sufficient flexibility to respond to market conditions	92
9	Reduce the overall amount of specialised skill and knowledge needed	76
10	Make capital funds available for more profitable operations	64
11	Combat the introduction of competition to the domestic supply	60

Appendix 5: Reasons for global outsourcing as perceived by survey respondents (Elmuti et al. 2000)

No of respondents	Goals selected	Attained goals	Projected percentage of improvements	Achieved percentage of improvements
70	PERFORMANCE (e.g. profit margins: return on investment; sales per employee; and higher stock values to investors	55	15-20	10-15
63	COST SAVINGS (e.g. Cost per unit of product or service compared to competitors)	40	20-25	5-10
40	PRODUCTIVITY (e.g.; efficiency rate, percentage of hours spent on production and output produced divided by input used)	24	5-15	5-10
30	CYCLE TIME (e.g. cycled time/asset turnover)	20	10-15	10 or less
24	CUSTOMER SERVICE (e.g., Customer satisfaction rates, repeat purchase, and retention rates	18	10-15	5-10
23	MARKET SHARE (e.g. Compared to past years and competitors)	16	less than 5	5 or less
20	QUALITY (e.g. percentage defects)	12	5-10	5 or less

Appendix 6: Specific goals for global outsourcing activities (over one year)

(Elmuti et al. 2000)

Quality Determined By	Buying Decision Influenced By
United States	
1. Well known name 2. Word of mouth 3. Past experience 4. Performance 5. Durability 6. Workmanship 7. Price 8. Manufacturers reputation	1. Price 2. Quality 3. Performance 4. Word of mouth 5. Well known name
West Germany	
1. Price 2. Well known name 3. Appearance 4. Durability 5. Past experience 6. Quality itself	1. Price 2. Quality itself 3. Appearance 4. Durability 5. Well known name 6. Design and style 7. Performance
Japan	
1. Well known name 2. Performance 3. Easy to use 3. Durability 4. Price	1. Performance 2. Price 3. Easy to use 4. Design and style 5. Well known name

QualityPerceptionASQC.xls

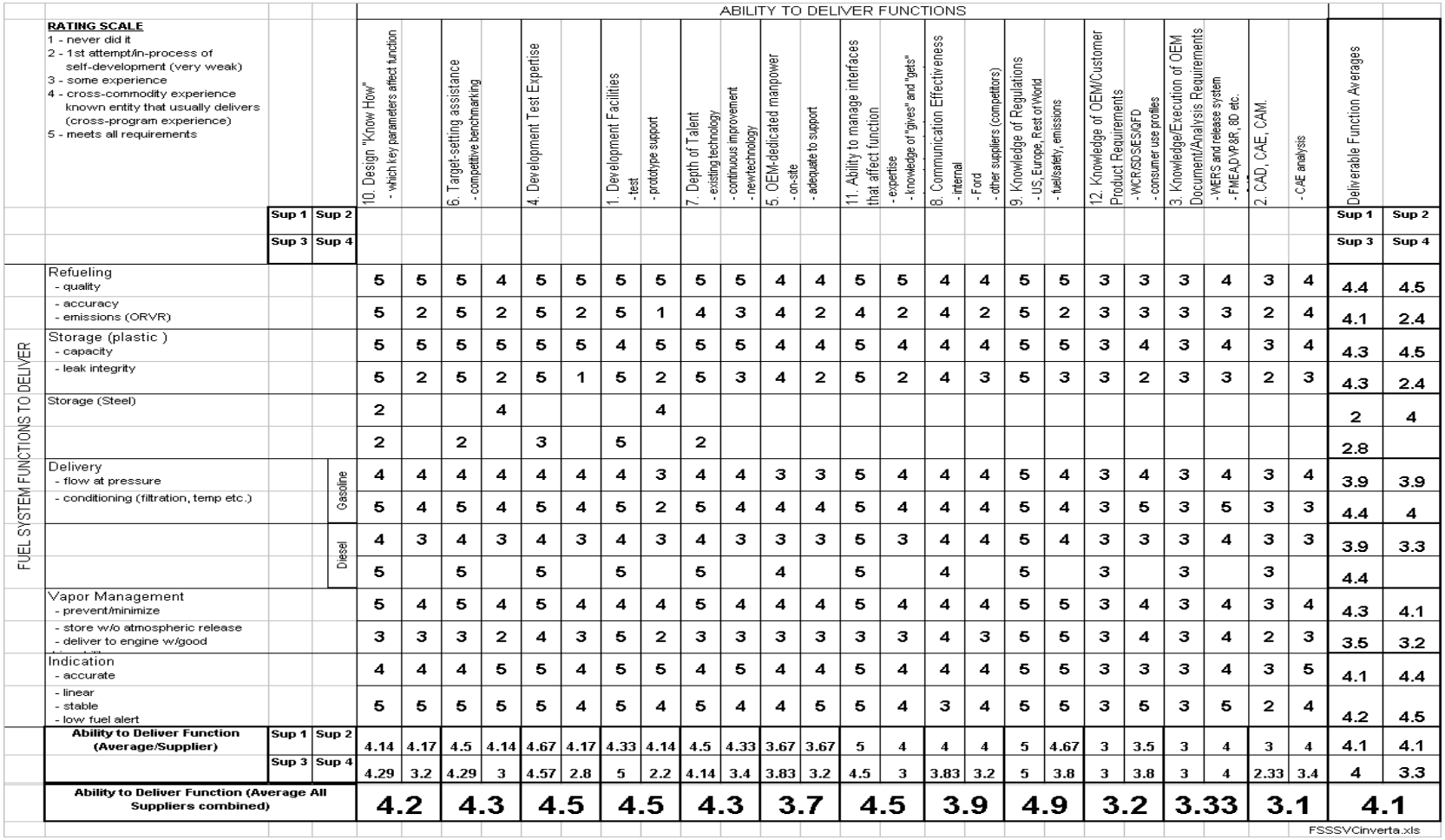
Appendix 7: Consumer Definitions of Quality: Summarized Results from American Society for Quality Control (ASQC/Gallup, 1991)

Successful Organisations
Fear of job loss and fear of change Poor choices of outsourcing partners Not enough training/skills needed to deal with type of global sourcing alternatives Inadequate comprehensive plans Cultural, legal and economics issues Decline in the morale and performance of the remaining employees Lack of supporting infrastructure Unclear expectations/unclear objectives Cross-functional political problems Poor organisational communication Problems can arise regarding confidentiality, security and time schedules Not enough high level management support Over emphasis on short term benefits Uncertainties in the environments Hidden costs and risks Inadequate control systems Lack of flexibility and keeping contract short
Unsuccessful Organisations
Unclear expectations/objectives Inadequate comprehensive plans Fear of job loss and fear of change Not enough training/skills needed to deal with type of sourcing methods Not enough high level management support Cultural, legal and economic issues Poor choices of outsourcing partners Decline in morale of the remaining employees Inadequate control systems Over emphasis on short term gains Lacking of supporting infrastructure Cross-functional political problems Poor organisational communication Problems – confidentiality, security and time schedules Lack of flexibility and keeping contract short Uncertainties in the environments Hidden costs and risks

Appendix 8: Factors affecting Global |Sourcing Projects in Successful and Unsuccessful Organisations (Elmuti et al. 2000)

Criteria	Measurement
Technology	Total quality supplier performance survey Manufacturing technology audit Investment in R&D
Quality	Parts per million defects Process quality index ISO 9000 accreditation
Responsiveness to changes in demand	Process change notifications Production control and capacity plans
Delivery	Lead times On time shipment performance
Environment	Environmental Improvement policy Environmental improvement plan
Financial stability	Credit ratings

Appendix 9: Hewlett Packard's Supplier Accreditation and Performance Criteria with Examples of Metrics (Lonsdale, 1999)



				ABILITY TO DELIVER FUNCTIONS																									
	RATING SCALE 1 - never did it 2 - 1st attempt/in-process of self-development (very weak) 3 - some experience 4 - cross-commodity experience known entity that usually delivers (cross-program experience) 5 - meets all requirements			10. Design "Know How" - which key parameters affect function		6. Target-setting assistance - competitive benchmarking		4. Development Test Expertise		1. Development Facilities - test	- prototype support	7. Depth of Talent - existing technology	- continuous improvement - new technology	5. OEM-dedicated manpower - on-site	- adequate to support	11. Ability to manage interfaces that affect function - expertise - knowledge of "gives" and "gets"		8. Communication Effectiveness - internal	- Ford - other suppliers (competitors)	9. Knowledge of Regulations - US, Europe, Rest of World - fuel/safety, emissions		12. Knowledge of OEM/Customer Product Requirements - WCR/SD/SE/SQFD	- consumer use profiles	3. Knowledge/Execution of OEM Document/Analysis Requirements - WERS and release system	- FMEA,DVP&R, 8D etc.	2. CAD, CAE, CAM. - CAE analysis		Deliverable Function Averages	
		Sup 1	**Sup 2**																									**Sup 1**	**Sup 2**
		Sup 3	**Sup 4**																									**Sup 3**	**Sup 4**
FUEL SYSTEM FUNCTIONS TO DELIVER	Refueling - quality			5	5	5	4	5	5	5	5	5	5	4	4	5	5	4	4	5	5	3	3	3	4	3	4	4.4	4.5
	- accuracy - emissions (ORVR)			5	2	5	2	5	2	5	1	4	3	4	2	4	2	4	2	5	2	3	3	3	3	2	4	4.1	2.4
	Storage (plastic) - capacity			5	5	5	5	5	5	4	5	5	5	4	4	5	4	4	4	5	5	3	4	3	4	3	4	4.3	4.5
	- leak integrity			5	2	5	2	5	1	5	2	5	3	4	2	5	2	4	3	5	3	3	2	3	3	2	3	4.3	2.4
	Storage (Steel)			2			4				4																	2	4
				2		2		3		5		2																2.8	
	Delivery - flow at pressure		Gasoline	4	4	4	4	4	4	4	3	4	4	3	3	5	4	4	4	5	4	3	4	3	4	3	4	3.9	3.9
	- conditioning (filtration, temp etc.)		Gasoline	5	4	5	4	5	4	5	2	5	4	4	4	5	4	4	4	5	4	3	5	3	5	3	3	4.4	4
			Diesel	4	3	4	3	4	3	4	3	4	3	3	3	5	3	4	4	5	4	3	3	3	4	3	3	3.9	3.3
			Diesel	5		5		5		5		5		4		5		4		5		3		3		3		4.4	
	Vapor Management - prevent/minimize			5	4	5	4	5	4	4	4	5	4	4	4	5	4	4	4	5	5	3	4	3	4	3	4	4.3	4.1
	- store w/o atmospheric release - deliver to engine w/good			3	3	3	2	4	3	5	2	3	3	3	3	3	3	4	3	5	5	3	4	3	4	2	3	3.5	3.2
	Indication - accurate			4	4	4	5	5	4	5	5	4	5	4	4	5	4	4	4	5	5	3	3	3	4	3	5	4.1	4.4
	- linear - stable - low fuel alert			5	5	5	5	5	4	5	4	5	4	4	5	5	4	3	4	5	5	3	5	3	5	2	4	4.2	4.5
	Ability to Deliver Function (Average/Supplier)	**Sup 1**	**Sup 2**	4.14	4.17	4.5	4.14	4.67	4.17	4.33	4.14	4.5	4.33	3.67	3.67	5	4	4	4	5	4.67	3	3.5	3	4	3	4	4.1	4.1
		Sup 3	**Sup 4**	4.29	3.2	4.29	3	4.57	2.8	5	2.2	4.14	3.4	3.83	3.2	4.5	3	3.83	3.2	5	3.8	3	3.8	3	4	2.33	3.4	4	3.3
	Ability to Deliver Function (Average All Suppliers combined)			4.2		4.3		4.5		4.5		4.3		3.7		4.5		3.9		4.9		3.2		3.33		3.1		4.1	

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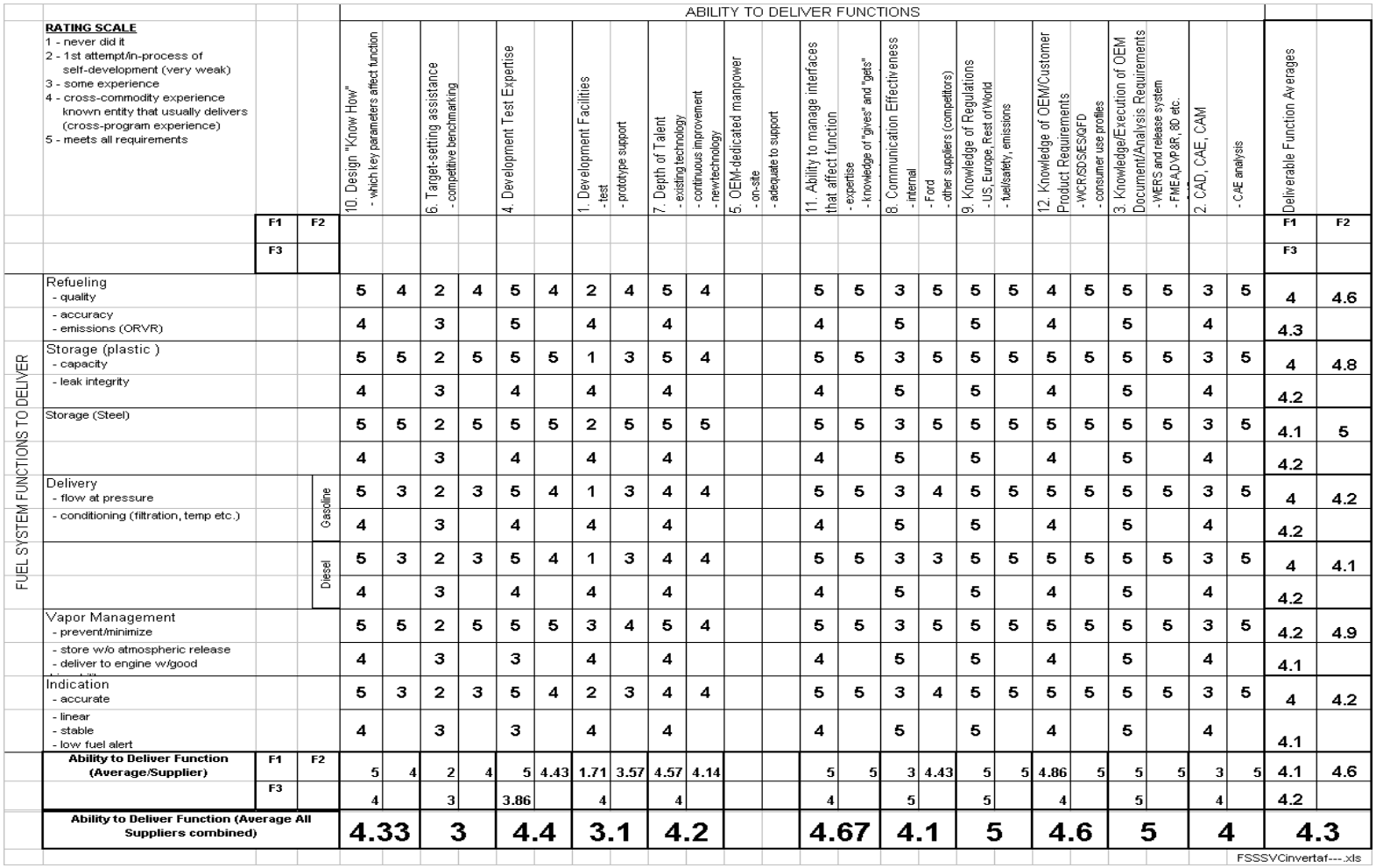
Appendix 10: Tier One Supplier Competency Evaluation



				ABILITY TO DELIVER FUNCTIONS																									
	RATING SCALE 1 - never did it 2 - 1st attempt/in-process of self-development (very weak) 3 - some experience 4 - cross-commodity experience known entity that usually delivers (cross-program experience) 5 - meets all requirements			10. Design "Know How" - which key parameters affect function		6. Target-setting assistance - competitive benchmarking		4. Development Test Expertise		1. Development Facilities - test	- prototype support	7. Depth of Talent - existing technology	- continuous improvement - new technology	5. OEM-dedicated manpower - on-site	- adequate to support	11. Ability to manage interfaces that affect function - expertise - knowledge of "gives" and "gets"		8. Communication Effectiveness - internal	- Ford - other suppliers (competitors)	9. Knowledge of Regulations - US, Europe, Rest of World	- fuel/safety, emissions	12. Knowledge of OEM/Customer Product Requirements - VWCR/SDSES/QFD - consumer use profiles		3. Knowledge/Execution of OEM Document/Analysis Requirements - VWERS and release system - FMEA,DVP&R, 8D etc.		2. CAD, CAE, CAM - CAE analysis		Deliverable Function Averages	
		F1	F2																									F1	F2
		F3																										F3	
FUEL SYSTEM FUNCTIONS TO DELIVER	Refueling - quality			5	4	2	4	5	4	2	4	5	4			5	5	3	5	5	5	4	5	5	5	3	5	4	4.6
	- accuracy - emissions (ORVR)			4		3		5		4		4				4		5		5		4		5		4		4.3	
	Storage (plastic) - capacity			5	5	2	5	5	5	1	3	5	4			5	5	3	5	5	5	5	5	5	5	3	5	4	4.8
	- leak integrity			4		3		4		4		4				4		5		5		4		5		4		4.2	
	Storage (Steel)			5	5	2	5	5	5	2	5	5	5			5	5	3	5	5	5	5	5	5	5	3	5	4.1	5
				4		3		4		4		4				4		5		5		4		5		4		4.2	
	Delivery - flow at pressure		Gasoline	5	3	2	3	5	4	1	3	4	4			5	5	3	4	5	5	5	5	5	5	3	5	4	4.2
	- conditioning (filtration, temp etc.)			4		3		4		4		4				4		5		5		4		5		4		4.2	
			Diesel	5	3	2	3	5	4	1	3	4	4			5	5	3	3	5	5	5	5	5	5	3	5	4	4.1
				4		3		4		4		4				4		5		5		4		5		4		4.2	
	Vapor Management - prevent/minimize			5	5	2	5	5	5	3	4	5	4			5	5	3	5	5	5	5	5	5	5	3	5	4.2	4.9
	- store w/o atmospheric release - deliver to engine w/good			4		3		3		4		4				4		5		5		4		5		4		4.1	
	Indication - accurate			5	3	2	3	5	4	2	3	4	4			5	5	3	4	5	5	5	5	5	5	3	5	4	4.2
	- linear - stable - low fuel alert			4		3		3		4		4				4		5		5		4		5		4		4.1	
	Ability to Deliver Function (Average/Supplier)	F1	F2	5	4	2	4	5	4.43	1.71	3.57	4.57	4.14			5	5	3	4.43	5	5	4.86	5	5	5	3	5	4.1	4.6
		F3		4		3		3.86		4		4				4		5		5		4		5		4		4.2	
	Ability to Deliver Function (Average All Suppliers combined)			**4.33**		**3**		**4.4**		**3.1**		**4.2**				**4.67**		**4.1**		**5**		**4.6**		**5**		**4**		**4.3**	

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Appendix 11: OEM Competency Evaluation

Factor No:	Competence	10	6	4	1	7	5	11	8	9	12	3	2	Total	Weighting
10	Design "Know How"	1	1	2	2	2	2	0	1	1	0	2	2	16	0.67
6	Target setting	1	1	2	2	1	1	1	1	1	0	2	2	15	0.62
4	Development Test expertise	0	0	1	2	0	1	0	1	1	0	1	1	8	0.33
1	Development Facilities	0	0	0	1	0	0	0	0	1	0	1	1	4	0.17
7	Depth of Talent	0	1	2	2	1	1	1	1	1	1	2	2	15	0.62
5	OEM dedicated manpower	0	1	1	2	1	1	1	0	0	0	1	1	9	0.38
11	Ability to manage interfaces that effect function	2	1	2	2	1	1	1	1	1	1	2	2	17	0.71
8	Communication Effectiveness	1	1	1	2	1	2	1	1	1	1	1	2	15	0.62
9	Knowledge of Regulations	1	1	1	1	1	2	1	1	1	1	2	2	15	0.62
12	Knowledge of OEM/Customer	2	2	2	2	1	2	1	1	1	1	2	2	19	0.79
3	Knowledge/Execution of OEM Documents/Analysis	0	0	1	1	0	1	0	1	0	0	1	1	6	0.25
2	CAD,CAE,CAM	0	0	1	1	0	1	0	0	0	0	1	1	5	0.21

Memo: 2=greater importance, 1= equal importance, 0=lesser importance. Kepner.doc

Appendix 12: Kepner-Tregoe Competency Weighting Analysis

Competency	Weighting	Supplier 1	Supplier 2	Supplier 3	Supplier 4	Combined Supplier Competency (Average)	Combined OEM Competency (Average)
10. Design "Know How".	0.67	2.77	2.79	2.87	2.14	2.64	2.88
6. Target setting.	0.60	2.7	2.48	2.57	1.8	2.39	1.8
4. Development Test expertise.	0.33	1.54	1.38	1.51	0.92	1.34	1.45
1. Development Facilities.	0.17	0.74	0.7	0.85	0.37	0.66	0.53
7. Depth of Talent.	0.62	2.79	2.68	2.57	2.11	2.54	2.60
5. OEM dedicated manpower.	0.38	1.39	1.39	1.46	1.22	1.37	N/A
11. Ability to manage functional interfaces.	0.71	3.55	2.84	3.19	2.13	2.93	3.34
8. Communication effectiveness.	0.62	2.48	2.48	2.37	1.98	1.83	2.54
9. Knowledge of Regulations.	0.62	3.1	2.9	3.1	2.36	2.87	3.10
12. Knowledge of OEM/Customer.	0.79	2.37	2.76	2.37	3.0	2.63	3.63
3. Knowledge/Execution of OEM Documents/Analysis	0.25	0.75	1.0	0.75	1.0	0.88	1.25
2. CAD, CAE, CAM.	0.21	0.63	0.84	0.49	0.71	0.67	0.84
Individual Supplier/OEM Combined Competency (Weighted Average)		2.07	2.02	2.01	1.65	1.94	2.18

Higher numbers in brackets represent a combination of higher performance & higher importance of competency. Kepner2.doc

Appendix 13: Kepner-Tregoe Analysis comparing Competency of Tier One Suppliers to OEM