International Journal of Automotive Industry and Management

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The Residual Value Function - Including the Estimated Brand Effects on Residual Values

Abstract - Used car value depreciates when the age and kilometers increases. The value of the vehicle at the end of the leasing contract is often called residual value. The depreciation of value of the vehicle is the most significant part of the cost of leasing. There are very large differences in the rate of depreciation between cars based on the characteristics of them. Some cars hold their value much better than the others. It is very important for the leasing business to identify which are the cars that hold their value the best and, more generally, to correctly forecast the car values at the end of the contract. For the manufacturer, it is very important that they can produce cars that hold their value well. This is because the cost of the ownership of the car is then minimized for the customer. Thus buyers try to find cars that hold value well.

Using large amount of data and statistical modeling (mixed models) it is possible to estimate the residual value function that relates the characteristics of the car and the expectation value of residual values as percentage of the new car value. This function is not constant in time. Rather, it is changing continuously, and usually rather slowly. There are many characteristics that have statistically significant effect on residual value percentage. One of the most important characteristic is the brand of the car. If we have two technically similar cars having the same new car price, the residual value as percentage of new car value differ very significantly based on the brand. Measuring the effect of the brand gives numerical estimate of the brand value, i.e. how much more or less the consumer is willing to pay for technically similar cars just because the brand is different. These brand values change slowly in time and we can follow the changes.

Korean brands are rather new in the car market of Finland. It is very interesting to follow the brand value development of these brands. For any new and rather unknown brand in any market, it is rather difficult to attain high brand value, because it is about trust and people generally don’t trust an unknown brand. In the Finnish car market Kia has been able to build valuable brand image quickly, which is very unusual. The secret has probably been a very well known retailer, intensive service program and the longest warranty in the market.

Keywords - Car leasing, Statistical modeling, Mixed models, Unlinear models, Residual values, Brand, Passanger cars, Depreciation, Value, Forecasting, Hedonic regression

Setting residual values is the core of the business of any leasing company. The part of the value that the car looses during the leasing period is called depreciation and we can define the residual value as follows;

\[
\text{Residual Value} = \text{New Car Price} - \text{Depreciation}
\]

Many times residual value is presented as percentage of its initial value. Depreciation of the car values is the most significant part of the cost of the leasing. The more the value
of the car depreciates the higher price the leasing company is forced to charge on the customer. If some manufacturers are able to produce such cars that hold value better than others, the leasing companies are able to sell the leasing contracts with lower prices than other cars having same price as new or the same production costs. Even outside leasing market, individual consumers seek cars that hold their value well. The depreciation of car value takes large part of the costs for the consumers. This can have large effect on the sales volume of the manufacturers. We can actually measure the realized residual values and depreciations using analyses of large car market data by comparing the used car price to its initial value. The future residual value refers to forecast of the future value of a leased car as percentage of its new car value today.

All leasing companies face the same problem around the world: how they should set the future residual values, and what would be the most reliable way of forecasting the value of the car at the end of the contract. If leasing company is bearing the risk and actually sells the car at the end of the contract, its profit for the car depends on the actual value at the end of the contract compared with the forecasted residual value. Leasing company can avoid risks by setting the forecasted residual values at the end of the contract very low. This means that the company have to charge high prices on its customer since the depreciation of the car value is expected to be large. But by doing so the leasing company will loose more customers since the competitor can offer better contracts to customers or many potential customers decide to buy the car instead of leasing it.

In order to be competitive and profitable in the car market, leasing company has to set the residual values in such a way that it will maximise its forecasted profit, not too high because it would mean losses and not too low because it would hurt the selling volume. There is very large variation in the rate of the depreciation of car values as the age and kilometers increase. Certain cars hold value much better than the others. For any leasing company it is very important to know which cars hold their value longer. So how is this usually done by leasing companies? According to our knowledge, it is often based on the educated guess by either leasing companies or some firms specialized in giving such forecasts. Those companies usually do not make public how they actually forecast the residual values.

In this paper, I try to propose a quantitative way to help the residual value estimation. By using large transactional price data and statistical methods, we can estimate the effects of the different characteristics on the residual values while keeping other things constant. We can estimate the function that relates the expectation value of the residual value percentage to the observable characteristics of the car. By estimating the function using the latest data we can estimate what the function is (or has been lately). However, to be able to set the future residual value, the value at the end of the contract, we should be able to forecast also what kind of changes will happen in the residual value function during the leasing contract. When forecasting the FRVF it greatly helps if we know what it is now and what it has been in the history and how it has changed during the recent history. Therefore to be able to forecast future RVF, we have to estimate the present and historical RVF. One of the main characteristics of the car that have effect on residual values is the brand (make) of the car. In this paper these brand effects are especially on focus although other results of estimation are presented as well. A lot of research has been made on automobile brands. Usually they are qualitative papers researching the image of the brand. In this paper I try to show how it is possible to measure and get numerical effects of brand as a part of the estimated residual value function.

**Literature Review**

Used car market and residual values of vehicles have not been empirically researched much. Akerlof (1970) created in his seminal work the theoretical model of adverse selection in durable goods market. According to the model, buyers cannot make distinction between the qualities of used cars, whereas the seller of the car knows the quality of the car he or she is holding. This asymmetrical information causes the cars of different qualities sell at a common price that reflects
the buyers’ estimate of average quality. As a consequence, the holders of cars of higher than average quality, hold their cars rather than trade them and holders of lemons sell their cars. Thus asymmetrical information structure leads to lower average quality in the market and even to the breakdown of the market.

Many empirical tests have been made on lemons model and many times they concentrate on adverse selection. Gilligan (2004) finds inverse relationship between depreciation and trading volume in the Used Business Aircraft Market and views it as evidence of adverse selection.

Gilligan (2004) also presents a theoretical model where in the presence of full information, the cars having high rate of depreciation of the quality, have also high rate of depreciation of value. Thus the prices reflect fully the true depreciation rates of different brands. I comment this model later in the conclusions of this paper.

But as Emons and Sheldon (2005) pointed out, the adverse selection does not necessarily imply information asymmetry. The results indicate that the probability of a vehicle having a defect increases if the car was sold privately. They also found that the opposite holds true for used cars sold by dealers. They find their results supporting both the presence of adverse selection and asymmetrical information.

I find these results of Emons and Sheldon very logical. The professional used car buyers are usually wise enough to detect defects in a used car. Private consumers are less able to find defects and thus a holder of a lemon is likely to sell his car rather to consumers. And the seller may don’t have a choice if the dealers just will not buy the car with a defect into their stock.

Some empirical research on automotive leasing markets has been also conducted. Pirotte and Vaessen (2008) made empirical analysis of residual value losses in automotive leasing sector.

Even though the above mentioned papers have something in common with the topic of this paper, they don’t have the same focus on residual value function and the effects of the characteristics on residual values. Very few or no academic research has been made on this very subject, about the relationship between residual value percentage and the characteristics of the car. This is surprising because this subject seems to be one of the most important for risk managers of every leasing company.

Rosen (1974) presented famous hedonic model in his article. Rosen sees the differentiated products as bundle of characteristics. The products can be fully defined as vectors of characteristics. Consumers are choosing between these packages of characteristics. There is a function that relates the price and the characteristics of the car. For car i having vector of k characteristics the price is function of these characteristics

\[ P_i(x_i) = P(x_{i1}, x_{i2}, ..., x_{ik}) \]

This is hedonic price function that relates the prices and its characteristics. The function can be estimated using statistical modeling and large enough price data. These kinds of hedonic models have been estimated for many products like housing or used apartments (Can 1992; Halonen 1996) and some durable goods (Halonen 1997) and used cars (Aalton-Setala and Halonen 2003). Hedonic price models are also often used in the calculations of Consumer Price Index to solve the quality change problem (Vartia and Halonen 1997; Haurin and Hendershott 1991)

In this paper the approach is rather similar to the hedonic price models. Instead of price, the goal is to explain the variation in residual value and estimate the function that relates the characteristics of the car and the residual value percent.

Data

The Overview and Sources of the Data
Grey-Hen Oy, an Autovista Information Solutions Company, gets the very large data as daily transfers from DMS-systems of car retailers. This company has presence in Finland, Sweden, Holland and UK. In this paper, only data of Finland is used, since there we have largest data and longest experience of analyzing the market. The data covers about 60 % of all used cars sold by franchised dealers in
Residual Value Percent of car $i$ is defined as where $PP_i$ is Purchase Price of the car dealer. If over allowance is used when buying a car, it is subtracted away from the price to get real purchase price.

$LP_i$ is a List Price of the car $i$ at the first registration date of the car. It excludes options and delivery costs.

We have the extra options of the car as different variable in the model and we can estimate the residual value of the car and the residual value of the options separately. As we are also interested in whether we could estimate the brand affects using only publicly available asking price data, we define showroom asking price residual value for car $i$ as

$$RV_P = 100 * \frac{PP_i}{LP_i}$$

In the final estimations we used log of these variables in the model. Residual Value Function is written shortly as RVF.

**Data Period and Restrictions**

Finland had a significant new car tax change in the beginning of the 2008. Based on that, some of the new car prices went up by over 20%. The average new car price level dropped by 7%. It was published on November 1, 2007 and immediately after that the used car price formation changed quite a lot. Also the level of used car prices dropped rather quickly in November 2007, even before the new car tax change was actually realized.

In this paper, the data from period November 25, 2007 - May 25, 2008 was used in the final estimation. The data consisted of over 44,000 observations. We left out small buses but the vans were included. We also left out rare brands in the market and the data of 33 brands were left in estimation data. Some of the observations were deleted since the different variables were not rational. For example, the used car price was 2 times higher than new car price. Also some very deviantly low prices were found to belong to cars which were out of order according to the information we got from authorities by using the registration plate inquiry. Otherwise we left the data not with standing the very deviant prices if no clear reason was found to delete them.
Cars that were over 6.5 years old or had kilometers over 250,000 were also left out. If the kilometers were really high, it was more common that there was really large deviations from the expected residual value probably because of larger variation in the condition of these more used cars. These kinds of cars are anyway not relevant for leasing companies.

The Model

The General Idea

The starting point of the modeling is that we can observe variation in the market prices of used cars and also in residual value percentage. We want to understand what explains this variation in residual value percentage. It can be easily found that the age of the car seems to have strong effect on residual value percentage.

In the figure 1 residual value percent RVP is plotted against age of the car from the date of purchase. Each dot is one car and there is over 44,000 cars in figure 1. The figure shows that the older the car, the lower is the average RVP. But we can also observe that there is also other kind of variation, not explained by age only. But what are these other factors and how do they affect the RVP? What kind of function relates the characteristics of the car and the residual value function?

Variables in the Model

In this paper, we use similar kind of hedonic approach as described earlier in this paper but the explanatory variable is not used car price but the residual value percentage. Here we assume that also the differences in residual value percentage are related to characteristics of the car. The explanatory variable which we are trying to explain is $\ln$ of residual value/new car price.

$$LRVP=\ln(RVP)$$

We explain the variation in this variable using the variables that are either characteristics of the car or transformed variables based on the characteristics. In addition, we use selling region because there are differences in price level among regions of Finland.

The brand (make) is a categorical variable in the model. All the common brands have their own estimates but the rarest makes are left out of the data. The brand also has an interaction with the age of the car and the kilometers.

The log of residual value percentage is a function of age, kilometers, characteristics of the car like power of the engine, body type, fuel consumption, fuel type etc., and brand (make). The result depends of course somewhat on how we define ‘similarity’ of the two cars even if we have found that small differences in the model do not change the estimated brand effects very much.

The effect of age and kilometers is not assumed to be linear but quadratic function having not points. Because there is a lot of data, whatever the shape of the relation between kilometers and residual value, we can find it by fitting a function that is flexible enough to find the shape of the data. The functional form is empirical, not theoretical question.

Since the brand has interaction with the age and kilometers, it allows that each brand has different effect of kilometer and age on residual value. We can test this hypothesis of different age and km slopes by brands. This specification of the model means that for each (age and kilometer) point we will have a different brand effect. We normally use the point of 3 years and 90,000 km as the reference point and we report the brand effects at this point. It is useful because the normal length of the leasing contracts is 3 years and the average contract kilometers are somewhat under 90,000 km. Also the
age distribution of the sold used cars has the greatest frequency at 3 years of age which means that we can most accurately measure the brand effects at this point.

The function that relates the characteristics of the car to the expectation value of residual values is in constant but rather slow change. For example, if we estimate the model using the used car price data period of January 1, 2006 - December 30, 2006, we get a bit different result from that of the data period January 1, 2007 - December 30, 2007. However, usually the result does not change dramatically over time.

When the model is used to forecast the residual values at the end of the contract, let’s say after 3 years, it also means that we cannot assume that the function would be the same when we get estimation using the latest data.

**Price Concepts and Residual Value**

As we have several price concepts for the very same car like showroom asking price, realized selling price, purchase price of car dealer, we can define residual value percent in several different ways. We can define,

$$RVP_{SAP}=100 \times \frac{\text{Showroom asking price}}{\text{Original list price}}$$

The benefit of this definition is that price concept is public and you have rather easy access to these prices. On the other hand, this is not 'real' value for the leasing company, but the price leasing company actually gets is much lower. In Finland the usual channel for leasing company to sell its car is to sell it directly to car dealers.

In some other countries, there are car trade markets where the leasing companies sell the cars at the end of the contract. So here we can define residual value percent as,

$$RVP=100 \times \frac{\text{Purchase price}}{\text{Original list price}}$$

Comparing the results from using the $RVP_{SAP}$ and $RVP$ is interesting. If they are rather similar, it means that just by modeling public showroom prices (or $RVP_{Sh}$) it is possible to get approximately right view of the percentage effects of brand and other characteristics on residual values.

**Options (Accessories)**

The options have an effect on used car price. Many of the options are standard, included in the car type without extra payment. The extra options are those that can cause within car type variation. The total value of extra options is used as explanatory variable of the model.

**Sampling Issues of Data and the Estimation Method**

The data is not simple random sample of the markets. First of all, it is collected from only franchised dealers. So these results concern directly only that market segment. We have made some experiments of using our price model to forecast the market prices of other market segment. The result was that the price formation is really similar also in the segment of non-franchised dealers not present in our data although there was small level difference between these markets (Aalto-Setala and Halonen 2003).

Secondly, the sample is clustered so that from the dealers we have data, we usually have all the sold cars and the cars for sale, but from part of the dealers have no data. This kind of clustered sample may cause that the car prices of the same dealer are statistically correlated and not independent as it is assumed in standard covariance model estimations (Dickey, Pantula and Rawlings 1998). To test this hypothesis and to take it into account, it is possible to use mixed model where the car dealer is used as random variable. The dealer effect is assumed to be normally distributed with mean zero and some unknown variance.

The estimated model was so called mixed model where other variables were fixed effects but the car dealer was used as random effect.

The mixed model estimation was executed using STAT module of the SAS system (Proc Mixed).

**The Results of Model Estimation**

**The General Performance of the Model**

The model explains the variation of the residual value well.
There is high correlation between real RVP and model estimate. Large majority of the variation of modelled variables can be explained by the variation in characteristics of the car.

Many variables that have statistically very significant effects on residual values were found with p-values smaller than 0.0001.

The figure 2 shows the histogram of residuals plotted against normal curve. The distribution is rather symmetrical and close to normal but it has somewhat heavier tails than normal distribution. It means that most of the cases the residual is close to zero and real residual value percent is close to estimate but in some rare cases the observed residual value percentage are far from the model estimate. There are some extremely low prices more often than extremely high.

The unexplained residual variation means that there are differences in residual values even the characteristics in the model are the same. This is natural since there is variation in the prices of every homogeneous product (Aalto-Setala 2003). If you buy a bottle of Coca Cola from 20 different shops, you can observe variation in prices. Used car prices don’t make any exception in this rule. Even if the characteristics are the same, we can observe different prices and residual values.

There can be many causes of this unexplained variation. During the 11 years I have spent in analyzing the car market of 4 countries, I and other people in our company have spent considerable amount of time trying to explain the part of the price variation that the models can’t explain. One reason I have found is that the situation in car dealers stock varies. In some moment of time a dealer has plenty of Ford Mondeo’s in your stock and the dealer is not willing to buy more. Thus he is willing to pay less for the same car than dealer that needs more of Mondeo into stock.

In the case of showroom asking prices, if the car has been in stock over 90 days, many dealers have a policy that the car must be sold fast even the price would be very low indeed. This kind of situations explain some of the lowest retail prices.

Second reason is that there can be variation in unobserved characteristics of the car. If, at the moment of purchasing the car, the dealer notice need of repairing in the car, the coming repairing cost are subtracted from the purchase price. This can be also the reason for the fact that there was more unexplained variation in residual value percentage using purchase prices than when using retail asking prices. So it seems that it is easier to predict accurately the retail price than purchase price. This may be because the condition of the car when selling it out is mostly good because dealers are forced to repair the cars by law, but when buying in there is more variation in the condition and in the need of repairing.

When we plot the residuals against age (Figure 3), it can be seen that most of the large negative residuals are a bit older cars. The extremely low price can be because of poor condition of the car. Many of the cases where we have large negative residual, the car is rather cheap. Because we used log of RVP as dependent variable, the large residual means...
large relative difference between the observed value and the estimate. If the car is cheap, the large relative difference is not large in sum of money. Even 3,000 euro is two times larger than 1,500 euro, the difference is ‘only’ 1,500 euro’. Within data of 44,000 cases, there can many times be these kind of cases.

One additional reason for deviant prices is that the seller and the buyer can have some kind of special relation. The buyer can be one of the managers of the car dealer or relative to some of them.

Largest differences are such that the observed price is only half of the model estimate, but in many cases the prediction is 3,000 euro and real price is 1,500 euro.

The non-linearity of kilometer effect is very clear. The proof that the model did find the shape of the residual values is the data in figure 4. The average value of observed and estimated log RVP was calculated by kilometer group. These averages of observed and estimated values were both plotted against kilometer class. The non-linearity is very clear but it is also clear that there is not much difference between the observed and the estimated value. Thus the model makes no significant systematic error in any of the kilometer groups and thus kilometer effect has been modeled accurately.

**FIGURE 4**
The Average Values of the Estimated and Observed Logs of Residual Value Percentage

The Estimated Brand Effects
The brand effect on residual values is statistically very significant (F=22.12, p<0.0001). This means that the probability that the brand has no effect at all on residual value percentage is lower than 0.0001 and in fact it is much lower. The interaction of brand with the age was still stronger than brand intercept (F=54.15, p<0.0001) and also the interaction with kilometers was statistically very significant (F=16.22, p<0.0001). This leaves little uncertainty that the brand of the car really has a major effect on residual values. This means that there are true differences between technically similar cars having same new car price in residual value percentage based on the brands. Moreover, there are true differences among brands, as to how kilometers and age affect their residual values. The brand effects were estimated for 33 brands. It is possible to calculate the brand effect at any age-kilometer point for each brand using the three estimated parameters.

The brand intercept tells what is the difference in brand effect at the point of zero age and zero km compared with average of all brands. Brand age tells the difference of age slope of brand b compared to reference group. So by using the estimated parameters of brand intercept, brand kilometers and brand age, we can calculate the brand effect for brand b at any age and kilometer point as,

\[ BE(Age, Km)_b = \alpha_b + \beta_b \cdot Age + \gamma_b \cdot Km \]

where \( b \) denotes brand of car.

So the brand effect is a function of three factors which are brand, age and kilometer.

We normally report the brand effect on residual value percentage at the point of 3 years and 90,000 km. This point is used because it is very common length of the leasing contracts and also because this kind of cars are really common in the data and thus the results are the most reliable at this point.

Now if we calculate this at the point of 3 years and 90,000 km we will have one estimates effect per brand. The estimated brand effects (BE) at the point of 3 years and 90,000 km are listed in table x both using showroom asking prices and purchase price data. The brand effects are all divided by the average brand effect. BE 100 means that it is average brand. 110 means that cars belonging to this brand have 10% higher expectation value of residual value than similar car having same characteristics and new car price, and average brand value.
Lexus, Toyota and Mercedes are the cars that have the highest brand effects of all. Among these, Lexus is rather rare in the car market of Finland, but it is well known that it was made by Toyota. Usually rare brands hardly do very well but there are exceptions.

German brands do especially well. Mercedes-Benz, Audi, Volkswagen, Skoda, Mini and BMW are all in top 10. Skoda is part of the Volkswagen group and consumers in Finland know it very well nowadays. Mini is also part of the BMW-group and well known as well. Although Opel is made in Germany, it is not usually regarded as German brand by consumers in Finland since it belongs to the GM group. Also Japanese brands do well. Besides the top performers, Lexus and Toyota, Honda, Mazda and Mitsubishi rank in top 12.

Separate estimations were made using purchase prices and publicly available showroom asking prices.

In the table 1 both results are shown. The correlation between these results is high. This suggests that by using publicly available portal asking prices, it is possible to estimate rather accurately the effects of characteristics on RVP. This is illustrated in the figure 5 showing the correlation plot of asking price and purchase price BE.

Table 1
The Brand Effects on Residual Values

<table>
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<tr>
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<td>Lexus</td>
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<td>114.989</td>
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<td>Toyota</td>
<td>112.626</td>
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<td>3</td>
<td>Mercedes-Benz</td>
<td>111.103</td>
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<td>Audi</td>
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<td>Mini</td>
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Korean brands did not rank well except one clear exception: Kia. Kia has been able to build strong brand rather fast. It has now higher brand value than Nissan, Peugeot, Ford and Opel which all have been popular makers in the car market of Finland for a long time. This does not happen so often. Usually best brands are old and take long time to build the value. The dealer network selling Kia is the biggest in Finland and has a brand of its own. It has power to advertise and make the unknown brand well known. In addition, giving longest warranty in the market is a wise move for an unknown brand. The consumers had then the courage to spend their money on unknown brand. When Kia was able to break into top 10 in the selling volume list, it gave even
more boost. Kia has very intensive service program which supports its maintenance also the long warranty itself supports the residual values since when buying three-year old Kia, the warranty of manufacturer is still valid for a long time. In the near future the residual values of Kia will be under challenge because the supply of used Kia’s in the market is increasing rapidly. Even so, it seems that Kia will be able to stabilize its position in the car market of Finland. As mentioned before, it is very rare that any new brand is able to break its way into the markets and get good position in the brand list in a very short time.

**The Time Series of Brand Effects**

We have been estimating residual value models now for 8 years and hedonic price models much longer. As mentioned, the residual value function is not stable but is constantly changing. To have some kind of picture of these changes in time, figures 6 and 7 present the brand effect development from late 2003 to March 2008. These results have been estimated using asking price data. Also there are small changes in the model during these years and compared with the model presented to this paper. However, according to my best knowledge, these time series show how the brand effects have been changing during these years.

What we can observe is that brand effects are constantly changing. Toyota has been best of all common brands during the last 3 years but in late 2003 Mercedes, BMW, Audi, Volvo and Volkswagen all had higher brand value than Toyota. But even there are changes, all these brands have been among the best and clearly above the average now at least for 4 and a half years. Skoda is the only of the top brands that was below average in late 2003. Large changes can happen in 3-4 years but only rarely.

One of the most dramatical changes during the past 5 years is the rise of Skoda from average brand to one of the best brands. Finnish consumers used to view Skoda as one of Eastern European brand, a brand of communism. Eastern Europe was at that time far behind the Western Europe in terms of technology. Skoda was one of the worst brands in the middle of the 90’s when Volkswagen group bought it. Now they finally found that it is one of the brands of Volkswagen group having very similar technology level as Audi and Volkswagen. All the other top brands have been in the top for at least 5 years. The surge from bottom to top took over 10 years. Also Toyota was viewed as low-end car in the 70’s and rushed from that image to the best brand. Mini is a curiosity, having high residual values even it is still very rare in the car market of Finland.
**Other Characteristics and Residual Values**

Even in this paper focuses on brand effects, we can find many other factors which have statistically very significant effect on residual values.

The strongest variable having highest F-value (=1856.48) is the change in the list price. When the new car price decreases, also the used car prices and residual value decreases but very importantly, less than new car value. In Finland there was considerable tax reform in the beginning of 2008 which caused the retail prices of new cars to change based on CO2-emissions. Mainly because of this, the effect was this time so strong. Usually the price changes of the same car type in time are rather small. Now they have been from -25 % to +25 % depending on fuel type and fuel consumption.

Fuel consumption has very clear effect on residual value, but even more importantly it has strong interaction with age. Because the estimated effect is positive, this means that cars that have low fuel consumption also have higher residual value because they lose value slower when the age increases.

The age of model generation is very strong explanatory variable having F-value of 434.71. For example, when new generation of VW Golf IV comes into market, it first has higher residual value but then the residual value of the same version at the same age km point decreases. This is very logical because as generation gets older, the consumers start to view it as old fashioned and do not value it so highly as in its first years of sales.

Note that the age of the model itself does not play a major role. It was not statistically significant having F-value of only 0.01. Also this is logical since there are many classical old models like Golf or Corolla that have high residual values but whereas old models like Mondeo or Laguna have low residual values.

The ending of the production of the car model (e.g., Nissan Almera) has clearly negative effect on residual values of the model. Very interestingly, only small part of the effect comes immediately after the ending. Majority of it comes year by year after the ending. The interaction between the ending of the model and the time from the end of the model has F-value of 77.37, p<0.0001).

**Conclusion**

In this paper it was shown, how we can estimate the residual value functions that relate the (expectation values of) residual value percentage to the characteristics of the cars. The data used was both public retail asking price data and the real purchase prices of the same vehicle. Data was obtained from the franchised dealers and car market of Finland. Especially the effect of the brand on the residual value was reported. The brand effect of residual value means that some brands seem to have higher residual value percentage than other even they are technically similar having same price as new.

The brand effect on residual values was statistically very significant. The brand had also very significant interaction between both age and kilometers. Thus there were statistically significant differences of the age and kilometers effects on residual value between brands.

Lexus and Toyota were the most valued brands in the car market of Finland. Out of these, Lexus is rare and Toyota is very common. These brands were followed by many German brands: Mercedes, Audi, Volkswagen, BMW, Skoda and Mini(BMW). The other Japanese brands, Mazda and Honda were the next. French, Italian and American brands did not perform well.

Other than brand, the new car price difference within the model was a very strong explanatory variable. The more expensive version of the model, the lower the residual value if the characteristics are kept constant.

New car price changes are also reflected very clearly on the residual values. If the new car price drops during the contract, the residual value drops too but not as much as new car price.

The model generation age had also very significant effect on residual value percent. For new generation of a model, the residual values are first higher but then gradually decrease before new generation again replaces it. The age of the model itself did not have any significant effect.

The results of estimation using purchase prices and retail asking prices were strikingly similar. This suggests that we can use most easily available portal asking price data to estimate the effects of brand on residual value and the effects of other characteristics too. Of course the level of the asking and pur-
chase price of car dealer is completely different.

We have estimated the brand effects for several years and we can form time series of brand effects. What we can observe in time series is that brand effects and ranking of brands do change continuously but rarely very fast and dramatically. One of the most dramatical changes during the past 5 years is the rise of Skoda from average to one of the best brands.

What are the brand effects? Why are consumers willing to pay more for similar car just for the brand? In my view, based on my eleven years as car market analyst and statistical modeling of large data from several countries, they reflect mainly the trust on the brand, i.e. the cumulative experience of the users of that brand. Car magazines also report about the reliability problems of different car models and brands. There seems to be clear similarities between reliability statistics like TUV-statistics of Germany and brand value even it has not been fully researched yet. Used car buyers seek cars that actually work and which have well functioning organization in place to serve the customer. Cars that start up reliably in the morning when you have to go to work and which last long when age and kilometers increase and which takes low cost of repairing and maintaining. Many buyers of used car market seem to have rather good information of the average long term reliability of the cars from different brands (but not necessarily about the quality of individual cars for sale) and thus the different depreciation rates of value reflect present and past true differences of depreciation rates of car quality between brands. Note also that not everyone needs to know about true quality differences. If considerable number of buyers does know, then it already will have an effect on used car prices and residual values. Professional used car buyers know cars rather well and car dealers are also defining the purchase and sales prices of the cars they are selling. The dealers are responsible for the quality problems 6 months after sales by law. Thus they are not willing to pay a lot for car having high probability of serious problems. Some brands suddenly would be able to raise the quality of their cars and thus the rate of true depreciation of quality would be smaller. However, it would not have immediately full effect on residual values since the buyers also give weight to past experiences of that brand. The quality image seems to change slowly. This would explain slow changes in the estimated brand effects. Smaller part of the estimated brand values are probably explained by hidden technical characteristics which are not included in the statistical model.

The estimated model is the present residual value function. As the RVF changes very slowly, leasing companies need to know the present and historical RVF but also the future RVF, at the end of the contract. As the function is changing usually rather slowly, even using the PRVF as FRVF is much better than to give every car the same residual value or just to make them up without any estimation. But being able to forecast how the PRVF changes to FRVF would still be much better. Methods that can be developed to forecast changes in RVF are valuable, but that would be a topic of further study.

REFERENCES


ACKNOWLEDGMENT

I wish to thank professor Yrjo Vartia for his education on statistical and economical modeling, biostatistian Hans Helenius for his wise advices on statistical modeling, professor Ville Aalto-Setala on his insight on econometrics and price modeling. I would also like to thank many professionals of leasing companies and car dealers for their insights on residual values and used car market. I also like to thank managing director of Grey-hen, Mikael Teerilahti, for the resources and support for the work and the members of my group Jere Sillanpaa, Esa Heimo and Ville Helasoja for their support. The suggestions of editor and two anonymous referees were very valuable for developing this paper.

Appendix 1

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[한국어 요약(Korean Abstract)]

중고차의 가치는 차량과 주행거리에 따라 감가상각된다. 리스 계약 차량의 경우, 계약 만료 시점의 차량 가치는 '잔존가치(residual value)'라 하며 차량의 감가상각은 리스 비용구조에 있어 가장 중요한 부분이다. 차량은 그 특징에 따라 감가상각률 차이를 보이기 때문에 리스 비즈니스의 관건은 어떤 차량의 가치가 더 오래 보존되는지를 확인하는 것과 계약 만료 시점의 차량가치를 정확하게 측정하는 데 있다. 이는 완성차업계에도 중요한 합의를 지닌다. 왜냐하면 잔존가치가 높은 차량일수록 소비자가 부담하는 비용은 낮아질 것이며, 그러한 차량에 대한 소비자의 선호도와 구매의향은 더 높아질 것이기 때문이다.

핀란드 자동차시장의 데이터와 해도닉 가격 모형(hedonic model)을 이용하여 차량의 특징과 신차 가격 퍼비 잔존가치의 비율을 예측하는 함수를 구할 수 있다. 변수로 사용되는 가격에는 소매가와 실구매가가 있다. 두 가격은 많은 차이를 보이나 각각을 이용한 추정 결과는 매우 유사했다. 따라서 브랜드 효과가 잔존가치에 미치는 영향을 추정하는 데 있어서 포털사이트에서 흔히 구할 수 있는 소비자 가격을 사용하는 것도 무방해 보인다.

잔존가치 비율에 영향을 미치는 변수는 매우 많으나 그 중 가장 중요한 변수는 브랜드이다. 가령, 가격 및 사양이 비슷한 차량이라 하더라도 브랜드에 따라 소비자의 지불 의향은 큰 차이가 있을 수 있는 것이다. 브랜드 가치는 시간이 지나면서 변화하지만 변화에는 상당한 시간이 소요된다. 짧은 시간에 브랜드 가치를 항상시키는 것은 매우 어려운 일이지만 예외도 존재한다. 대표적인 사례가 스코다와 기아자동차이다. 스코다의 경우 핀란드 시장에서 평균 수준의 브랜드였으나 5여 년에 만에 상위권 브랜드로 도약하였다. 그리고 유럽인에게 생소한 브랜드였던 기아자동차의 인지도와 신뢰도가 빠르게 상승하고 있다. 생소한 브랜드가 단기간에 이렇게 높은 평가를 받는 것은 어려운 일임에도 불구하고 기아자동차는 핀란드 자동차시장에서 빠르게 성장하여 브랜드 가치를 인정받고 있다. 그 원인으로 핀란드에서 가장 긴 기아차의 보증기간이 상당한 영향을 미친 것으로 추측된다. 보증기간도 잔존가치에 영향을 미칠 수 있는데, 3년 된 기아자동차를 구매할 경우 보증기간이 여전히 남아 있기 때문에 잔존가치가 높은 것이다.

동일한 차종을 기준으로, 신차 가격은 잔존가치와 부(−)의 관계에 있다. 즉, 다른 조건이 일정할 경우 고급형 차량의 잔존가치 비율은 더 낮았다. 신차 가격의 변화 또한 중요한 변수이다. 계약기간 중 신차 가격이 낮아질 경우 잔존가치도 떨어지거나 신차 가격의 할인율보다는 폭이 작은 것으로 나타났다. 또 다른 변수는 차종 세대로이차이다. 신 모델(new model) 출시 직후에는 잔존가치가 일정기간 유지되나 새로운 모델이 기존 모델을 대체하는 시점을 기준으로 잔존가치는 점차 줄어든다. 마지막으로 핀란드 시장에서 차량의 연식은 잔존가치에 큰 영향을 미치지 않는 것으로 나타났다.
Modularisation Development Path in the Auto Parts Industry: Comparison of Korea and Japan

Abstract - Modularisation provides new challenges for the automobile industry. Following the trend, this study empirically compared the cases of Korea and Japan. This study finds out the characteristics of modularisation dynamics in Korea which are different from those of Japan. The results show that modularisation of Korean automobile industry is shifting to modularisation in inter-firm system which outsources the subsystem to the outside suppliers, based on modular (open) supply chain (organizational) architecture unlike Japan. Typically, mega suppliers such as Hyundai Mobis produce module systems and OEMs purchase them. Also, mega suppliers make an effort to develop module systems. On the other hand, modularisation of Japanese automobile industry is shifting to modularisation in OEM production which insources the sub-system and assembles the customized parts. Japanese 1st tier suppliers develop and provide the customized parts and Japanese OEMs purchase the parts from the 1st tier suppliers and assemble complete car as a whole. Thus, while Japan is based on integral organizational architecture in supply chains and modular product architectures of parts, Korea is based on modular organizational architecture in supply chains and integral product architecture of module.

Keywords - Modularisation, Product architecture, Supply chain architecture, Inter-firm systems

Managing supply chains is an essential part to obtain competitive advantages. Especially, activity configuration and activity coordination in the supply chain are critical elements for competitive advantage (Porter 1986). Activity configuration is to determine whether each value activity disperses or concentrates within the supply chain. Activity coordination is to coordinate among the divided value activities within the supply chain through sharing and accumulating information, know-how, and expert knowledge.

Meanwhile, the concept of modularisation is not just sub-assembly at the supplier side but also module development or systemization that suggests the best system with idea and design. Systemization type module means that module makers do not physically assemble some related parts, but develop the lighter, the better, and the more qualified module with less number of parts. For such a systemization-oriented mod-
ularisation, the value activity coordination through sharing the information and knowledge is most needed. Thus, the necessary conditions of advanced modularisation in terms of quality include definite support of IT (Information Technology) as a tool of activity configuration. In the present auto industry, modularisation is used as a tool for value activity configuration among supply chains, while e-SCM (electronic Supply Chain Management) is used as a tool for activity coordination.

Modularisation has 3 different dimensions, which are modularisation in product architecture, modularisation in production, and modularisation in inter-firm systems (Takeishi and Fujimoto 2001). Modularisation in product architecture indicates shifting to integral architecture. Modularisation in production means standardization of component design within an automaker and functional independence/interface simplification. Modularisation in inter-firm systems is to outsource subsystems in larger units to outside suppliers.

In an automobile industry, one vehicle needs around 20,000 of 5,000 kinds parts through various processes like design, production, and assembly. It is impossible for one company to handle all these parts and processes. Thus, automobile assembly companies and part companies are complementing their value activities each other. This fact implies that the automobile is a system product which is integrated with different categories of activities. Configuration in the automobile industry changes cell-based configuration to module-based configuration in value chains. Modularisation comes from classical configuration like deal of complexity (Baldwin and Clark 1997). As current automobiles are more complex than those in the past, the module as a sub-system provides with higher flexibility to designers, manufacturers, and users by dividing complex systems into several pieces. These pieces, which are called modules, play a role of outsourcing assembly functions to the company. Modularisation refers the idea to develop a group of parts with independent units by designating the interface. Module makes complex systems or processes by linking other sub-system based on its own rules.

This study has a purpose to verify the model empirically to explain correlation between modularisation strategies as a tool of configuration. This will develop the process of coordination and configuration to obtain competitive advantage.

**Conceptual Framework and Research Setting**

Takeishi and Fujimoto (2001) suggested the three facets of modularisation which are modularisation in product architecture, modularisation in production, and modularisation in inter-firm systems. Figure 1 shows the three modularisation types and its trends.

The data on the trends of modularisation were collected from Korean automobile 1st tier suppliers. The survey questionnaires were mailed from June 1, 2002 to August 31, 2002. In order to obtain more responses, a follow-up letters and follow-up calls were delivered to the designated respondents after the initial questionnaire administration. 450 survey questionnaires were sent out to Korean automotive 1st tier suppliers (a survey was administered for each 1st tier supplier of the four major car makers in Korea: Hyundai-Kia, GM-Daewoo, Ssang-Yong, and Renault-Samsung). Among 182 responses, 5 were classified as being inadequate due to incomplete answers or void responses. 177 responses were used for the analysis. The descriptive statistics of the valid 177 samples are shown in Table 2, 3, and 4. Overall, the spread by OEM
customer mirrors production volumes by these manufacturers, and thus eliminates any concerns regarding a bias towards a certain vehicle manufacturer.

**Table 1**

<table>
<thead>
<tr>
<th>Percent of Suppliers’ Sales to Major OEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Ratio of Major OEM</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>0-20%</td>
</tr>
<tr>
<td>21-40%</td>
</tr>
<tr>
<td>41-60%</td>
</tr>
<tr>
<td>61-80%</td>
</tr>
<tr>
<td>81-100%</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Table 1 outlines the number of major customers by supplier. In our view, this is a critical prerequisite in developing in-depth and collaborative relationship with customers, because multi-customer suppliers will always face concerns with loyalty and confidentiality.

**Table 2**

<table>
<thead>
<tr>
<th>Categories of Suppliers by Product Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component</td>
</tr>
<tr>
<td>Power train</td>
</tr>
<tr>
<td>Steering, brake and suspension</td>
</tr>
<tr>
<td>Body and chassis</td>
</tr>
<tr>
<td>Battery and parts</td>
</tr>
<tr>
<td>Electric parts and wiring</td>
</tr>
<tr>
<td>Interior</td>
</tr>
<tr>
<td>Wheel and tire</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Not applicable</td>
</tr>
</tbody>
</table>

Table 2 outlines the products supplied by the companies surveyed. Again, the spread of components is important to avoid any bias towards a certain component cluster, production technology or process (e.g., metal pressing or plastic molding).

**Modularisation Trends in Korea: Compared with Japanese Suppliers**

This study analyzed the overall trends of modularisation-related factors in automobile industries. In order to find out what the modularisation efforts result in detail, comparing with transactions four years ago. This study used questionnaires with 7-point Likert type scales. However, to compare the trends between Korea and Japan, 7-point scales was mathematically changed into 5 point scale by \( Y = (X - 4) \times 2/3 \). Also, Japanese results are based on the study of Takeishi and Fujimoto (2001). 4 factors for trends of modularisation suggested by Takeishi and Fujimoto (2001) are as follows.

1) Standardization of component design within an Automaker
2) Architectural integrality
3) Functional independence
4) Expansion in sub-Assembly Scope

This study tried to make a comparison with Japanese results of Takeishi and Fujimoto (2001). As a result the biggest changes modularisation characteristics in product architecture over the last four years was a shift to integral architecture not only in Korea but also in Japan. In the trends at the modularisation in production, Japan is at relatively higher level than Korea. However, in the trends at the modularisation in inter-firm systems, Korea showed relatively higher level than Japan. That means Korean suppliers have made more attempts towards modularisation in inter-firm system.

As shown in the above Table 3 and Figure 2, Korea and Japan have similar trends in modularisation in product architecture. However, both countries show big differences in modularisation in production and modularisation in inter-firm system. In detail, Japan has higher level of standardization and functional independence, which are required in modularisation in production, than Korea. But, modularisation in inter-firm system has opposite result. Korea has higher level of expansion in sub-assembly scope, which indicates modularisation in inter-firm system. The following figures explain this situation in a different way.

Today, modularisation provides new challenges for the automobile industry. It becomes a big practical issue, irrelevant of architecture issue of the automobile industry. Particularly, Korean automobile industry, mainly
Hyundai and Kia, is aggressively pushing for modularisation. They are pursuing to reduce costs and increase productivity through module type suppliers such as Hyundai Mobis that focus on developing systemized modules with new materials and function integration. Subsequently, modular design is accelerated in part industries and improved three factors of competitiveness in automobile industries: cost saving, time saving, and quality improve-
ment. Korea automobile company improved the effectiveness of product design and manufacturing.

The following figures explain the trends in detail. According to Figure 5, Korea has higher levels of modularisation in product shifting to integral architecture. Especially, Korea is more likely to need structural coordination with other components such as checking matching and interference, while Japan decreased component steps and costs to assemble the component with the adoption of integrally-molded parts.

FIGURE 4
Dynamics of Modularisation in Parts Industry: Components Architecture vs. Module Architecture

<table>
<thead>
<tr>
<th>COMPONENT ARCHITECTURE</th>
<th>INTEGRAL</th>
<th>MODULAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTEGRAL</td>
<td>GEM: Design of the entire system as a whole, Part Design, Approved</td>
<td>Module Design, Approved, Module of GEM</td>
</tr>
<tr>
<td>MODULAR</td>
<td>Module Design, Approved, Module of GEM</td>
<td>Japan: Outsourcing Component Design, Production</td>
</tr>
</tbody>
</table>

note: 6. Component design was shared by different models of the same automaker.
7. Component design was shared between different variations of the same model.
13. Designs of interfaces (such as contact points) were shared by different models of the same automaker.
14. Designs of interfaces (such as contact points) were shared between different variations of the same model.

FIGURE 5
Modularisation in Product: Shift to Integral Architecture

<table>
<thead>
<tr>
<th></th>
<th>Korea</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>0.67</td>
<td>0.62</td>
</tr>
<tr>
<td>18</td>
<td>0.69</td>
<td>0.63</td>
</tr>
<tr>
<td>19</td>
<td>0.79</td>
<td>0.63</td>
</tr>
<tr>
<td>5</td>
<td>0.27</td>
<td>0.47</td>
</tr>
</tbody>
</table>

note: 17. Production of the component became more complex (with more function required).

18. Need for functional coordination with other components increased.
19. Need of structural coordination with other components (such as checking matching and interference).
5. Component steps and costs to assemble the component decreased with the adoption of integrally-molded parts.

FIGURE 6
Modularisation in Production: Standardization of Component Design within an Automaker

<table>
<thead>
<tr>
<th></th>
<th>Korea</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.22</td>
<td>0.44</td>
</tr>
<tr>
<td>7</td>
<td>0.23</td>
<td>0.57</td>
</tr>
<tr>
<td>13</td>
<td>0.13</td>
<td>0.28</td>
</tr>
<tr>
<td>14</td>
<td>0.11</td>
<td>0.44</td>
</tr>
</tbody>
</table>

note: 8. Component design was standardized across different automakers.
10. The number of variations within a vehicle model decreased.
According to Figure 7, comparison between Korea and Japan reveals big difference in standardization of component design across different automakers. Korea has higher levels in the number of variations within a vehicle model than in standardized component design across different automakers. However, in the case of Japan, the levels are similar.

**FIGURE 8**
Modularisation in Production: Functional Independence / Interface Simplification

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>11</th>
<th>12</th>
<th>15</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea</td>
<td>-0.01</td>
<td>0.06</td>
<td>0.07</td>
<td>0.13</td>
<td>0.10</td>
</tr>
<tr>
<td>Japan</td>
<td>0.21</td>
<td>0.13</td>
<td>0.19</td>
<td>0.08</td>
<td>0.11</td>
</tr>
</tbody>
</table>

**Note:**
1. Size of the component reduced with the same basic structure.
11. The number of interfaces (such as contact points) with other components decreased.
12. Designs of interfaces (such as contact points) with other points were simplified.
15. Designs of interfaces (such as contact points) were standardized across different automakers.
16. Function of the component became more self-contained (independent).

When comparing both countries in terms of functional independence and interface simplification in modularisation in production, Japan has much higher levels than Korea. The reduced size of the component with the same basic structure shows big difference between two countries. In both countries, function of the component became more self-contained (independent) to a similar degree.

Comparison between current and earlier models reveals opposite results between both countries. Korea has used standardization of component design by component sharing between current and earlier models. But, Japan has rarely did.

In figure 10, Korea has expanded sub-assembly scope in modularisation in inter-firm system. In detail, unlike Japan, Korea has increased the number of parts making up the component, increased the number of assembly process steps for the component, and incorporated component into another assembly component.

**FIGURE 10**
Modularisation in Inter-firm System: Expansion in Sub-assembly Scope

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea</td>
<td>0.23</td>
<td>0.28</td>
<td>0.38</td>
</tr>
<tr>
<td>Japan</td>
<td>0.02</td>
<td>0.09</td>
<td>0.07</td>
</tr>
</tbody>
</table>

**Note:**
2. The number of parts making up the component increased.
3. The number of assembly process steps for the component increased.
4. Component has been incorporated into another assembly component.

**Conclusion**

Through questionnaire survey empirically comparing the case of Korea and that of Japan, this study found out that Korean and Japanese automobile industry showed differences in modularisation development path. Korean product architecture is shifting to outsourcing sub-system with the strong cooperative inter-firm system, while Japanese prod-
uct architecture is shifting to insourcing sub-system. Typically, mega suppliers such as Hyundai Mobis produce module systems, along with an efforts to develop them and OEMs purchase the module systems. Meanwhile, Japanese 1st tier suppliers develop and provide the customized parts to OEM and Japanese OEMs purchase the parts from them and assemble complete car as a whole. Thus, while Japan is focusing on organizational integral architecture and modular product architecture of parts, Korea is focusing on modular organizational architecture based on supply chain and integral product architecture of module developed by mega module supplier.

REFERENCES


ACKNOWLEDGMENT

This work was supported by the IMVP(International Motor Vehicle Program), MIT.
[한국어 요약(Korean Abstract)]

본 연구는 경쟁우위 창출을 위해 가치사슬 내 활동배치의 도구인 모듈화 전략(modularisation)을 후지모토(Fujimoto)의 연구모형을 기반으로 한국과 일본의 완성차업체의 사례를 통해 비교·분석하였다. 한국의 완성차업체는 모듈형 공급사슬을 발전시키면서 외부 부품업체에게 서브 시스템을 아웃소싱하는 방식으로 부품업체 간 시스템에 바탕을 둔 모듈화를 진행하고 있다. 그 결과 현대 모비스와 같은 전형적인 대형부품업체를 발전시켜 나가고 있다. 한편, 일본 자동차업체의 모듈화 추세는 표준화된 제품을 완성차업체가 주도적으로 내부화하고 서브 시스템화하는 형태로 진행되고 있다.

한국과 일본이 추구하는 모듈화 전략은 상이한데, 그 공통점과 차이점을 정리하면 다음과 같다. 첫째, 부품 간 구조적/물리적 상호연결성이 점차 중요해짐에 따라 모듈화하는 한국과 일본 완성차업체에서 공히 추구되고 있다. 둘째, 일본은 지속적인 부품 최적화 설계를 위해 기업 내 혹은 부품업체 간 부품설계에 있어 표준화를 추구하는 반면, 한국은 과거에 설계한 부품을 지속 사용하고 있어 부품설계의 표준화 추구율이 일본보다 낮은 것으로 나타났다. 셋째, 부품 및 모듈의 크기에 있어서, 일본은 부품의 기본구성은 유지하면서 크기를 줄이고 있으며 차체 마운팅 설계도 단순해진 것으로 나타난 반면 한국은 모듈 크기에 큰 변동이 없으며 마운팅 설계에도 큰 변화가 없는 것으로 나타났다. 마지막으로, 서브 어셈블리(sub-assembly), 즉 단위 장치·모듈 조립에 있어서 한국이 일본보다 해당 부품을 구성하는 부품 수가 많고 다른 부품의 하위 조립에 들어가는 부품화 비율이 높은 것으로 나타났다. 연구 결과를 종합해 보면, 한국의 자동차업체는 공급사슬 아키텍처에 기반하여 서브 시스템을 아웃소싱하는 기업 간 시스템에서의 모듈화를 취하고 있는 반면, 일본의 자동차업체는 완성차업체 내에서 조립의 최적화를 위한 부품설계와 인터페이스의 표준화를 통한 생산의 모듈화를 추구하고 있다.

결론적으로, 한국의 모듈화는 서브 어셈블리 시스템을 통합함으로써 원가절감과 조립시간 단축, 공정 내 불량률을 낮춰 품질 향상에 기여하고 있다. 하지만, 기존 부품의 공용화보다는 부품 간 인터페이스 최적화하고 경량화할 수 있는 핵심 부품을 개발해야 하는 과제를 두고 있다. 이러한 부품의 최적화를 통해 부품업체 간 모듈화뿐만 아니라 일본 메이커와 같은 완성차업체 내에서의 공정의 인터페이스까지 최적화를 이룰 때 한국 완성차업체 만의 생산의 모듈화는 성숙의 단계로 진화할 것이 다.
The new politico-economic, technological and ecological environment led organizations to realize that they must change and restructure the way
of establishing and maintaining relationships. Consequently, an alliance or network approach based on flexibility, joint planning, shared information, adaptations, shared interests and objectives among firms emerged as an effective approach to meet the challenges and opportunities of the new environment.

Over the last decade considerable attention has been put on the changes occurring in the business environment. Of particular interest is the change in the nature of business relationships, and particularly the marked shift from adversarial to more strategic alliance relationships and networks (Zineldin and Dodourova 2005; Agndal and Chetty 2007).

The explosive growth of Foreign Direct Investment (FDI) led primarily to the globalization of markets. FDI grew at much higher rate in the 1980s and 1990s than world output and world exports (World Investment Report 2000). FDI inflows dramatically rose from $250 billion USD in 1990 to $1.3 trillion USD by 2000 (World Investment Report 2001) and the total FDI has reached $4.23 trillion USD and 12.59 million Jobs have been created in the past five years (OCO Monitor 2007). Global FDI inflows grew in 2006 for the third consecutive year to reach $1,306 trillion USD, the second highest level ever recorded (World Investment Report 2007). Among developing regions, Asia remained the main magnet for FDI flows, followed by Latin America (World Investment Report 2006). FDI flows to Latin America and the Caribbean rose by 11% in 2006, to reach $84 trillion USD. Mexico and Brazil, with inflows of $19 billion USD each, remained the region’s leading FDI recipients (World Investment Report 2007).

Given the enormous increase of FDI, the choice of entry modes is an important research question. Multinational enterprises (MNEs) follow two paths leading to three modes of market entry that involve equity investments, i.e. Wholly owned subsidiaries - either through a Greenfield venture or by an acquisition - a JV with a local partner.

The literature on modes of entry is extensive (Davis et al. 2002; Hennart and Reddy 1997; Pan and Tse 2000; Zejan 1990; Herrmann and Datta 2006; Zhang et al. 2007). In a comprehensive review, Datta et al. (2002) report 14 studies that used host industry characteristics as predictors. Of these, only three used all three types of equity participation, i.e. acquisitions, JV, and wholly owned subsidiaries as modes of entry. Although the literature provides some clue as to how a firm selects a particular partner or country, less is known about the international business relationship and establishment process, motivations and achievements (Geringer 1991; Zineldin and Dodourova 2005).

Entry mode choices and the establishment processes are often massive, irreversible, can influence the long-term performance of the firm and can have significant and far-reaching consequences on a firm’s performance and survival (Shrader 2001; Ekeledo and Sivakumar 2004). Therefore the different relationships during and under the establishment process and of entry mode is a very important decision for MNEs competing globally (Herrmann and Datta 2006; Zhang et al. 2007).

Yet, experience with international strategic relationships and networks have shown that they face a number of problems, which can often result in relationship failure (Zineldin and Dodourova 2005). Most of the limited number of previous studies provides insights about the critical events and case studies of the establishment processes of strategic relationships between foreign companies, how and to what extent the networks change or affect a firm’s positions in the market and how the macro-environmental forces affect the establishment process are not, according to our knowledge, well empirically investigated. The structure of the networks can be different in different environments and that would create a varying nature of opportunities and obstacles to the firm being established. As a result, the establishment process becomes different in different environments and the firm has to be able to develop mechanisms to capitalise on the opportunities and to deal with the constraints. The specific purpose of this study is to identify the unique characteristics of the Mexican industrial networks environment and how these characteristics can shape and influence the establishment process. Considering the above reality of the insufficient cases available regarding the Swedish companies’ establishment process in Mexico, to get deep insight and understanding of the establishment process, such research issue cannot be approached by means of a quantitative study. Therefore a qualitative case study is a relevant research strategy to study the establishment process of
Swedish firms in Mexico.

Specifically, the main goal of this paper is to describe and analyze how the Mexican industrial market networks and environmental issues such as cultural, financial, economical, legal, political factors etc. have affected (influenced) and shaped the establishment processes of Swedish firms in Mexico.

**Theoretical Framework(s)**

Ekeledo and Sivakumar (2004) and Zhang et al. (2007) argue that there are shortcomings and limitations of the internationalization theory and the eclectic theory regarding entry mode strategies and choice. Recently, Agndal, H. and Chetty, S. (2007) highlighted the importance of relationships, in particular their influence in market entry and mode changes. They have found out that multiple dimensions of a relationship (e.g., relationship level and type) seem to play an important role during the establishment process in international markets. We will, therefore study the establishment processes from a different perspective and approach, i.e. the relationship perspective which includes interaction, interactive and network approaches.

**The Interaction Approach**

Hakansson (ed.) (1982) developed an ‘Interaction Approach’ which is an appropriate tool to study buyer-seller relationships in industrial markets. The approach explains the interaction process between seller and buyer in terms of four variables, which are the environment, the atmosphere, the interacting parties and the interaction process. Hakansson (ed.) stressed that industrial relationships are frequently long-term, close and involve a complex pattern of interaction among the parties involved. The importance of the interaction/network approach is that all the four major components and their sub-variables must be seen together in order to understand the nature of relationships and the factors influencing them. Within given environment, organizations must develop clear, real, and strong relationship management and marketing orientation in formulating organization policy and mission.

Relationships that partners ultimately deem successful involve cooperation and coordination to create new value together rather than a mere exchange (Kanter 1994; Gronroos and Ravald 1996). The interaction process is influenced by the atmosphere and the environment where they operate. In turn, the atmosphere is influenced by the characteristics of the parties and the nature of the interaction. The atmosphere can either facilitate or make the relationship complicated. This atmosphere can be described in terms of power/dependence which exists/emerges over the life cycle of a relationship among the parties, the technological leadership, skills and competence, the organizational size, structure, strategies and experiences, the state of cooperation/conflicts, uncertainty, closeness or distance of the relationship, and by the partner’s mutual expectations at both the individual and organizational level.

Creating such strategic relationship is the efficient way to cooperate through strategic networks, as long as the sum of production and organizational costs is less than ‘going at alone’. In short, the partners believe that their success does not require others to fail. Their philosophy is that in the spirit of trust and commitment, the win-win approach is effective to create a bigger pie and then obtain a bigger share of it. The main principle of the network and interaction approaches is to seek out opportunities to create new values together and achieve synergic effects.

In such a relationship, the partners can create new value by reducing the transaction cost, uncertainty and the level of the financial and practical risks associated with the purchase or JV. Moreover, there is a great opportunity to gain access to vast information about, for example, partner’s needs, wishes, business and investment plans, which provides a substantial competitive advantage in strengthening the strategic cooperation.

**Partnership in supply chain relationships is clearly a very powerful strategy. It encourages a joint approach to problems and it can lead to reductions in costs, improvements in quality.** (Lamming 1993)

A sustainable partner relationship offers the partners with advantages and opportunities (Juttner and Wehril 1995). Partners can establish an alliance to develop collaborative...
programs beyond their legal boundaries in research and development, production and joint sourcing. This will lead to significant benefits and synergetic effects such as: economies of scale, lower costs, skilled labour force, high research & development level, access to superior engine technology, access to new markets, greater customer value-added is achieved at less total cost. All this will ensure profit for all the partners in the alliance or network.

**A Relationship/Network Approach**

During the 1990s there has been an increasing interest in the development of strategic alliances, dynamic networks, and other "loose" cooperative variants between organizations of all sizes, industries, and nationalities (Faulkner 1992; Webster 1992; Jarillo 1993; Hunt and Morgan, 1995; Elg and Johansson 1996). Some factors that underlie the importance of merging the new network and collaborative approach are aggressive globalization and internationalization "emerging from the global village", increasing homogenization of tastes and attitudes, deregulation and elimination of physical, fiscal/financial and technical barriers, rapidly advanced scientific and technological innovations, economic turbulence and predictive uncertainty (Mckenna 1991; Faulkner 1992). The main reason is that most organizations cannot always have the resources or know-how to cope with increasingly complex environments from internal resources alone.

The growth of interorganisational cooperative forms of business activity calls into question the nature and boundaries of the basic building blocks of economic analysis: the firm, the industry and the national economy. The traditional categories of the economist become less and less useful as basic building blocks for analysis. (Faulkner 1992)

In traditional western market economies, firms within an industry compete with each other for the customers’ favours. Cooperation and collaboration constrained by national governments. Today’s globalization and other environmental changes compel large and small organizations to recognize that the essence of a company is to cooperate within a network of different partners (Faulkner 1992; Hunt and Morgan 1995). The emphasis is now on strategic relationships in the form of alliances and de-integrated networks (Jarillo 1993).

The knowledge to establish and develop strategic relationships or networks in a foreign market provides a company with the tools to achieve a large scale of operations and substantial growth. A network perspective connects the synergy with the energy. Kotler (1994) emphasized the unique advantages of relationship marketing as follows:

*The ultimate outcome of relationship marketing is the building of a unique company asset called a marketing network. A marketing network consists of the company and its suppliers, distributors, and customers, with which it has built solid, dependable business relationships. The operating principle is to build good relationships, and profitable transactions will follow.*

The basic rule is that a strategic approach, e.g., network system, business relationship/alliances, should start from the customer, match the organizations internal and external resources/energy, and create a competitive edge.

Synergetic benefits often are the basis for unique competitive advantages that can be achieved through cooperation between collaborators, for example, shared experience, entrepreneurial and managerial skills, unique culture and spirit, know-how, production processes or efficient distribution outlets, unique effective and efficient use of cash flow, and ability to go abroad or to substitute own investments in foreign markets (Zineldin et al. 1997). Such synergies can also determine why one firm is very successful in, for example, a product-market and the other is less so.

**The Evolutionary Pattern of a Relationship**

Hakansson (ed.) (1982) developed the Interaction approach which defines marketing as all the activities to build, maintain, and develop relations with customers, distributors, suppliers, public institutions and individuals. This approach stresses the significance of the long-term nature of buyer-seller interactions and the factors that influence the relationship. The process of establishing and developing buyer-seller relationships is described in different stages.
While the IMP approach is limited to buyer-seller relationships, Zineldin (1995) contributed the evolutionary pattern of the development of a relationship. The concept of evolution is originally connected to the scientific idea that plants and animals develop gradually from simpler to more complicated forms (e.g., evolutionary biology). Evolution, according to Darwin’s theory (year), is defined as the gradual and incremental change and the development of an idea, situation, or objects (or plants and animals).

Establishing healthy, close, and strong relationships are supposed to evolve through different phases—each stage representing a major transition in how the parties involved are connected to each other. It is a dynamic exchange process where the relationship takes, to some extent, an evolutionary pattern and moves progressively from one phase into another, depending on how the parties deal with and treat each other.

In essence, the Relationship Evolutionary Pattern proposes a very similar life cycle for creating and enhancing healthy relationships, i.e. that an infant relationship is born and then goes through various phases, e.g., childhood, growth, and maturity in its life and becomes a strategic business relationship (Zineldin 2002). This pattern is based on the phase-by-phase approach to be useful in managing one-on-one relationships.

Almost any relationship begins with recognizing or identifying needs and desires and ends with satisfaction or disappointment and failure. Between the stage of need to the stage of satisfaction/dissatisfaction, there will be expectations, communications, actions, co-actions, reactions, commitments, problems, conflicts, and other activities associated with the willingness/unwillingness of one or both of the partners involved.

**An Interactive Perspective**

A relationship-oriented organization looks outward to the environment in which it operates and which has a major impact on the actors such as customers, competitors, marketing intermediaries, and suppliers. To develop a long-term relationship in today’s global economy (village), and highly competitive climate, it is important for a company to first understand how the environmental forces affect its marketing activities, relationships, networks, alliances, and consumer attitudes and behaviour. (Thorelli 1986; Zineldin et al. 1997). This holistic and interactive perspective views economic performance as a dynamic interaction between institutions. According to Douglas C. North (1993), one of the Nobel prizes winners for the Economic Sciences in 1993:

**Institutions are the humanly devised constraints that structure human interaction. They are made up of formal constraints (rules, laws, constitutions), informal constraints (norms of behaviour, conventions, and self imposed codes of conduct), and their enforcement characteristics. Together they define the incentive structure of societies and specifically economies.**

Marketing and organizational problems have to be viewed in an open, dynamic and behavioural system context that interacts with its environment, receives inputs from the environment, processes these inputs and exports outputs to the environment. The relationship and the interaction process among companies are influenced by the environment surrounding them. Thus, the system as a whole is heavily dependent and relies on either the behavioural science, or non-economic sciences (e.g., psychology, sociology, anthropology), and the economic sciences including political economy. Hakansson (1982) states that:

**The Interaction between the two parties does not take place in a vacuum. On the contrary, it is part of a large social system. Thus, the features of the environment influence the interaction in several ways. For instance, the environment may determine the alternatives open to both the selling and the buying firm.**

**Environmental Forces and Relationships**

The current rapid environmental changes resulted in an emphasis on the importance of building and keeping a close relationship between companies, customers, and other business parties (Berry et al. 1983; Fulkner 1992; Webster 1992; Zineldin 1998, 2000; Aijo 1996). In traditional marketing, the relationship perspective was not emphasized, as the
environmental forces were not sufficiently strong as it is today. Aijo (1996) hinted at this stating that:

*It will be shown that early attempts to formulate a general theory of marketing already included a relationship perspective. However, this perspective did not acquire the importance it has today, because the environmental factors were not sufficiently strong at the time... These (environmental) changes resulted in an emphasis on service, close customer contacts, and a holistic view of the parties and processes involved in marketing and business.*

All management and marketing activities occur within legal, political, economic, and social environment to which strategies and policies must relate. Zineldin et al. (1997) states that:

*The seller and buyer companies operate within a wide context and a large social system. The characteristics of this large system influence the relationship and interaction between the two organizations.*

Ford (1993) also hinted at this and pointed out the following:

*We must also consider the characteristics of the wider environment surrounding a particular relationship- the social system.*

Today, organizations face a different world and they must seek a different road to the future (Webster 1992). To do this managers’ must draw upon the accumulated experiential-learning and yet to be aware of the fundamental differences between the past situation and what they face today. Learning through time, experiences, the significance of institutions (e.g., political, economic, regulatory) and the nature of institutional change, are some key aspects that have a significant impact on corporate policies and its economic performance (Porter 1986).

**Major Macro Dimensions Affecting the Business Establishment**

Economic systems and conditions, competitive market structures and trends strongly influence marketing activity in all aspects. The economic system determines how a society allocates resources. Economic changes derive from broad secular movements in various underlying economic factors and from business cycles (Jobber 1995; North1993). As the marketing activity is strongly influenced by the business cycle, the economic environment is closely observed by managers. Therefore, current economic conditions and changes have a broad impact on the success of marketing strategies. The changes in economic and competition conditions affect the forces of supply and demand. Moreover, they influence organizations’, marketers’ and customers’ decisions, hierarchies and activities (Thorelli 1986; Powell 1990).

However, creating a system of networks and alliances with other high-tech companies provides the means to create a competitive advantage for a company (Dickson 1994). For governments, companies and consumers, practices from the 1980s are suddenly no longer relevant owing to the recent political, legal and regulatory changes. A minor change in any of the political, legal and regulatory dimension can have a major impact on a national or multinational enterprise (Dibb et al. 1994; Zikmund et al. 1995). It also influences the way of building relationships and networks with domestic and/or foreign suppliers, subsidiary, authorities and public as well as private customers.

It appears that society becomes more concerned about marketers’ activities which have questionable or negative ethical consequences (Dibb et al. 1994). New attitudes and behaviours are demanded from management and marketers towards the overall society. They have to create healthy societal relationships. Relations towards consumers, suppliers, subcontractors, other domestic and foreign organizations, employees, shareholders, the natural resources, the community and government have to be reconsidered. The green movement is increasing general awareness of the physical environment and is altering product design, manufacture, packaging and use (Gedicks 1994). It is clear that in the 1990s, many organizations recognized that business operates only with a license from society.

Finally, the 1990s technological, political, legal and regulatory, social, ecological, economic and competitive change offer organizations with a number of very important choi-
es. They will be faced with both opportunities for new business and threats to their existing markets. The extent to which companies are affected by the removal of barriers by 1990s depends upon how they respond to the challenges posed.

**Mode of Entry Industry Structure**

The increase in international collaboration and relationship is attributed to increased globalization and rapid changes in competitive environments (e.g., Beamish and Delios 1997; Robson 2002). Hence, globalization of markets in recent years was primarily due to the explosive growth of entry into foreign markets. Firms have the option of choosing the appropriate entry mode for international markets based on balancing their resources, motivations, expected achievements, capabilities, and international experience with their desire for ownership and control. International diversification through foreign market entry can result in high growth and profitability unavailable in home markets (Root 1994). Several studies have examined the performance differences between the different modes (acquisitions or Greenfield ventures, joint venture, direct and indirect exporting). (Nitsch et al. 1996; Pan and Chi 1999; Pan et al. 1999; Shrader 2001; Simmonds 1990; Malhotra et al. 2002; Herrmann and Datta 2006; Zhang et al. 2007). Aulakh and Kotabe (1997) suggest that is not just entry mode per se, but the "fit" between mode of entry and transaction-specific factors, organizational capability, and strategic factors that affect firm performance.

Extensive research supports the entry mode choice using a transaction cost approach (e.g., Anderson and Gatignon, 1986; Hennart 1988) and firm characteristics (Chang 1995). Transaction cost theory also suggests that the choice of entry mode depends on host country characteristics. Hennart (1991) argues that in resource- and technology-intensive industries, firms use shared-control modes to access local resources. Similarly, at the country level, the influence of national culture on entry mode choice has been supported (Shane 1994). Eclectic theory suggests that in developed countries, wholly owned subsidiaries have the highest long-term potential (Dunning 1988; Ekeledo and Sivakumar 2004). Erramilli et al. (1997) found that even the firm-specific advantages of Korean MNEs were dependent on host country location. Therefore, the role of host country characteristics on entry mode, of which industry structure is an underlying element, is well established.

A firm seeking to operate abroad must determine the most appropriate mode, or institutional arrangement, for the new host-market entry (Anderson and Gatignon 1986). Modes of entry differ in the degree of control the parent firm maintains over its foreign operations. Decisions concerning the modes of entry to particular foreign markets are among the most important that management has to take. Once the entry method is selected, its implementation has significant implications for a wide range of international marketing concerns. The entry methods chosen has to be related to the company’s overall strategies, goals, motivations and the time period in which it wishes its objectives to be achieved. The options for foreign market entry are: indirect and direct entry, strategies without international investment and strategies with international investment. Indirect and direct marketing entries often are referred to as export marketing.

Indirect market entry is passive exporting which occurs when the exporter uses independent organizations located in a foreign country. The main concern under this category is that the sale is like a domestic one where the firm is not really engaged in global marketing, because its products are carried abroad by others. The five main entry modes of this category are: export commission house, broker, trading company, export management company and piggybacking. This entry mode is most appropriate for a firm with limited international expansion objectives. The skills and know-how developed abroad are accumulated outside the exporting firm. The exporting firm has its advantage because the exporting firm avoids the overhead and administrative costs and burden related to the management of its own export activities and the firm may not even know in which country the product is sold (Johansson 1997; Petersen and Welch 2002).

Direct market entry: this is an active exporting activity and effort to enter foreign markets, which involves the use of domestic and international based intermediaries. The
commitment and required investment is greater than indirect exporting, the expecting rewards are also greater, and the firm has the better control of exporting activities and it has better possibility to learn how to operate overseas. It is not until the firm decides to hire its own overseas staff that a more strategic involvement in foreign markets becomes feasible (Johansson 1997). Direct exporting modes, however, include three main options which are export through foreign-based against, distributors/or establishing a sales or representative subsidiary.

Strategies without international investment (contractual relationships): Industrial or commercial expertise and know-how can be sold to foreign countries via licensing, franchising or through the provision of technical expertise under a ‘contractual manufacturing’ and/or ‘management contracts’. These entry modes involve minimal amounts of partner interdependence and have quite specific tasks, whereby each partner could terminate the agreement without great cost (Zineldin et al. 1997; Petersen and Welch 2002).

Strategies with international investment include bilateral agreements and strategic alliances. Such alliances include JVs, establishing of foreign branches and/or subsidiaries (including DFI in manufacturing plant) and consortia, whereby the partners make substantial investments in developing a long-term presence at the targeted foreign countries and common goal orientation or direction.

A sales/representative subsidiary is different from a wholly owned manufacturing subsidiary. A sales/representative subsidiary manages marketing and distribution operations in the foreign country. Usually the product is exported from the parent country or from another foreign plant. Such options allows full control with no dilution of profits to other operators or agents, and it allows the foreign company to take advantage of financial incentives from the host government, lower labour costs, access to raw materials and different labour and staff skills and culture elements as well as organisational learning (Johanson and Vahlne 1992; Sharma and Johanson 1987; Zineldin et al. 1997; Johansson 1997; Petersen and Welch 2002).

In a Greenfield investment, a foreign firm starts operations on its own in a host country. This results in the creation of new capacity/supply in a particular industry. The onus is on the entrant to provide all the requisite resources and capabilities for the investment to overcome industry structural barriers and risks due to liabilities of foreignness. In an acquisition, the foreign firm merges with or acquires an established entity in the host country. Acquisitions are used when time is an important issue in the investment decision, as it can be done much faster than a Greenfield or joint venture entry.

Previous scholars suggested that the link between mode of entry and firm performance was dependent on the “fit” between mode of entry and transaction-specific factors, organizational capability, and strategic factors that affect firm performance (Aulakh and Kotabe 1997). The results of the present study indicate support for the premise that foreign firms seek to reduce the risk posed by host country industry barriers by choosing modes that attenuate industry barriers or stabilize industry structural characteristics in host countries during entry. This strategy by the overseas entrant, during entry, allows it to participate in the host country industry with current incumbents while maximizing its own performance. Each of these modes has, however, a particular mix of cost, risk and ease of control (Bartlett and Ghousal 1989; Brooke 1992).

The Applied Model of Establishment Process and Its Development

Two different approaches of foreign market establishments were taken into consideration, discussed and compared before developing a model of establishment process in (Abraha 1994). The two approaches are the direct investment theory and the network approach. According to the direct investment theory which is developed on the basis of the theory of internationalization (e.g., Vernon 1966; Kindleberger 1969; Hymer 1976; Dunning 1980; Doz 1986; Porter 1986; Hennart 1982), establishment process in foreign markets is based on the strategic planning by managers, and its implementation is the role of the single firm itself. Moreover, according to this theory, the establishment
process of the firm has to be planned in advance where the elements of the plans are adhered strictly and implemented carefully in order to ensure its success. The cooperation with other firms in this theory is totally ignored as it implies that the whole establishment process is a full responsibility of the top management of the firm. (Abraha and Mukhtar 2002) also state that the establishment process of a firm, according to this theory, is believed to be dictated by the strategic vision set by the management of the firm.

Whereas, the network approach focuses on the numbers and types of business relationships built and maintained with other firms/actors in the foreign market that are active in the development of those relationships (Johansson et al. 1994). The subject of establishment process is defined in more or less the same way by stating that if one considers the market as a network, establishment means that the establishing firm obtains a unique position in a network which is new for the firm and its counterparts (Hammarkvist et al. 1982). The same source also claims that the establishment process can take place when a new firm enters a new geographic area and also when a firm develops relationships with new customer groups using new or existing products. The applied model was developed on the basis of this theory, i.e. the theory of marketing in industrial markets developed by Hagg and Johansson (1982), Johansson and Mattsson (1988), and Hakansson (1989), and which is generally called "the network approach". The fundamental ideas and concepts of this approach are accounted for in Johansson and Mattsson (1984, 1987), Hakansson and Johansson (1979, 1987), Johanson (1989), Mattsson (1983) and Eslsasser (1984). On the basis of the network approach, several studies of business network relationships and international business connections developments have been conducted both in the domestic and international market (Blankenburg 1996; Hakansson and Shnehota 1995; Mattssen and Johanson 2006; Waluszewski 2006; Baraldi and Stromsten 2006; Gadde and Araujo 2007). In a related phenomenon Cook and Emerson (1978, 1984); Burt (1982) and Granovetter (1985) developed and discussed social networks. Accordingly, industrial networks are viewed as sets of connected exchange relationships among actors who control industrial resources and activities. The industrial network refers to the exchanges of resources and the activities performed in the exchange process, whereas the social network refers to actors and their social relationships. The network approach mainly addresses the exchange of various resources where social relations are an integral part of this.

Therefore, in this article a model of establishment process developed on the basis of the industrial network approach briefly discussed above is applied as a theoretical framework. Reviewing the literature about the establishment process, Abraha (1994) found out that most research on establishment process focused on developed countries and the developing country markets have received much less attention. It meant that, understanding of establishment processes within the context of developing countries remains an issue for future research. To bridge the gap, Abraha (1994) examined Swedish firms’ establishments in Kenya by applying the above referred model3). This research resulted in Abraha’s doctoral dissertation titled "Establishment Processes in an Underdeveloped Country: The Case of Swedish Firms in Kenya." As it is clearly illustrated in the model (see Figure 1) below, establishment process in developing countries is observed to take place in four stages (Abraha 1994; Abraha and Hyder 1997, 2000; Abraha and Mukhtar 2002).

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3) This model was developed by Abraha (1994) on the basis of the network approach and applied in his doctoral dissertation.

4) This section is adopted from Abraha and Kaynak (2002) , "Foreign Market Entry in a Transitional Environment: The Case of Swedish Firms in Poland:"

5) The model of establishment processed developed and applied by Abraha (1994) was modified and developed further by Abraha and Hyder (1997, 2000) and Abraha and Mukhtar (2002) when it was applied to study establishment process in different countries markets.
The four phases (variables) are (1) the historical identification development of the establishment process, (2) the and discussion of the focal relationship(s), (3) the various supporting relationships developed by the establishing firm to enable the focal relationship(s) to function properly, and (4) the general or the macro-environment. Abraha (1994) conclusively recommended that such a study should also be directed towards other countries that differ from Kenya in some of the variables considered in his study.

Based on the above recommendations, several studies of establishment processes have been conducted by applying the above briefly presented model. The specific studies were conducted by Abraha and Hyder (1997 2000), Abraha and Mukhtar (2000), Abraha and Kaynak (2001) and Abraha, Osarenkhoe and Awuah (2006). It was very interesting to observe that establishment processes can differ in different countries markets due to the differences; in the various countries level of development, market structures, industrial infrastructure and tradition, product characteristics and macro and micro environmental factors. Considering the recommendations and the different findings in different countries markets, the specific aim of this article is to examine how establishment processes of Swedish firms in Latin American countries and specifically the Mexican market looks like.

**Research Methodology**

The automotive industry is selected as it is the threshold of the Swedish economy and it has witnessed tremendous changes due to increase of the worldwide globalisation. The scientific work, to a large extent, aims at generating theories based on facts, which could be interpreted in different ways. It is, therefore, a question of research design and the design must be described so that the relevance is clarified (Von Wright 1993; Glaser and Strauss 1967). Case study methodology has always a source of generating new insights. We adopt what Yin (2003) describes as a multiple case, embedded design. Our study is both exploratory and descriptive, thus the case study methodology is to be conducted in order to generate new knowledge and insights. The specific reasons for applying the case-study approach are (i) due to the fact that the establishment of a firm is viewed as a process that requires a holistic perspective, and a case study that covers the development of the whole process chronologically addresses this requirement. According to Chetty (1997), case studies offer a holistic view of the phenomenon and explain the reasons why certain decisions were made, how they were implemented and with what result. (ii) Abraha (1994) argued that the case study approach enables the researcher to present a complete picture of a study object, including all relevant facets over a certain period of time. Therefore, the establishment process has to be studied in depth with few case studies, if a complete picture of the process, including all the important events that took place during the course of the establishment is to be realized. (iii) The case-study is an appropriate research method when a subject is complicated and involves inter-organizational relationships Hyder and Abraha (2003). This study is also complicated among other things due to the fact that human relationships over national boundaries are in focus and secondly establishments in general and specifically in this work involves firms/actors with different social, political, economic and legal backgrounds factors that have a considerable impact on the phenomenon under consideration.
This study is based partly on theories, concepts and ideas which are developed in international business, strategy, management and marketing and partly on traditional approaches and criteria that are developed and used by manufacturing organizations to measure the international business performance. The two approaches are applied together with a case approach to gain deeper understanding of the research issues.

In summary, the methodology of the present study can be summarized as following:

First, based on the previous survey, literatures, theories, concepts and researches, we believe that the area of investigation is somewhat (relatively) new, so that an exploratory study is to be made in order to provide a better understanding on the areas of interest and to develop a conceptual framework. This approach can generate new knowledge and insights enabling us to deeply understand the complex nature of the phenomenon examined by explaining how certain events/processes evolved over time, their consequences, why certain decisions were made, how they were implemented including their consequences is more or less addressed in (Chetty 1997; Yin 2003; Ghauri and Gronhaug 2002).

Second, the case study for this approach is concerned with detailed analysis of a limited number of events or conditions and their inter-relationships. A descriptive case study that documents the nature of the automotive industry in Mexico and the establishment processes of two Swedish manufacturers companies is employed. The study focussed on case research of Scania and Volvo. Information is collected through semi-structured interviews, i.e. both telephone and email interviews with some key figures of both organisations in both Mexico and Sweden.

The data collection methods: In the case of Scania semi-structured email and telephone interviews, i.e. data collection instruments, are applied. Email interview was conducted with Scanias Corporate Relations Manager in Latin America in three different days for approximately five hours in 2005 and 2007. It was the general manager who decided that interviews have to be carried out with this specific respondent. The general manager confirmed that the interviewee has several years of experience and is a qualified informant who can provide adequate information. In addition, three telephone and one email interviews were carried out with Scanias Corporate Relations Press Manager in Sodertalje in 2005 and 2007. This respondent was recommended by Scanias public relations manager in Latin America stressing that the respondent has worked in the company for a long period of time and possess adequate knowledge about the phenomenon under consideration. Telephone interviews were conducted in three different days for total three hours. The respondent is judged to be a qualified respondent from the detailed information that he provided for every question asked. Before the respondents were selected, the author was asked to send the questions to be answered by the company management. After receiving the questions, the company management carefully read and discussed the questions within the company management and the author to select the interviewees. Both respondents also expressed their readiness to provide further information whenever necessary. Transcripts were made of both the email and telephone interviews and they were sent to the respective interviewees for correction. The respondents were instructed that they don't need to return the manuscripts if there is no need for correction and additional information. The transcripts were returned to the authors with few and essential corrections.

In the case of Volvo, three semi-structured email interviews, i.e. data collection instruments, are applied. The first interviewee is responsible for the sales of trucks in Latin America and he was email interviewed for about three hours in 2005. He works in the Volvo office in Mexico. This person has worked for several years in the Volvo office in Mexico and is considered to be a qualified respondent by both the company and the interviewer. He was recommended by the Volvo head office in Sweden as he has maintained a high ranking position in the company for a considerable period of time. Additional email interview was done with the marketing and communication manager in Volvo Mexico for about four hours in three different occasions in 2005 and 2007. It was the first interviewee who recommended the authors to contact the second interviewee whenever addi-
tional information was necessary. The respondents’ position enables him to possess adequate and relevant information and that can help us to determine that he is a qualified respondent. Both respondents were selected by the company management after carefully reading the interview questions that were prepared by the authors. When the interviewees were asked if they were ready to provide additional information, they declared that it depends on the workload they will be having during the specific time. Transcripts were made of the two email interviews and they were sent to the respective interviewees for correction and additional information. The transcripts were returned to the authors one with few whereas the other with some more corrections. Both interviewees were informed that there is no need to return the manuscripts to the authors if no correction is done and no fresh information is provided.

The data analysis methods: It can clearly be observed from how the cases are structured that the authors have started the analysis by preparing a historical account of the cases. A combination of the interview content analysis (Yin 2003) and the multi-step qualitative-process of data reduction, data display and conclusions-drawing (Miles and Huberman 1994; Pettigrew 1997) methods of interpreting and analysing the empirical findings have been applied in this article.

To secure triangulation, two methods of data collection, both primary and secondary data and a model developed by combining different concepts extracted from several but closely related approaches/theories have been applied. Moreover, various sources and types of data have been used, compared and analysed in order to triangularize the data, the methods and the conclusions drawn. In addition, the various sources of data have been compared and analysed by keeping strict attention to the various concepts/themes in the model so that robust conclusions will be drawn that can enable us to address the research problems and the purpose of the article. The final aspect of analysing the data is done by comparing the two cases in light of the main concepts/themes of the model which is developed from the various theories and models discussed in our literature review.

The reason for selecting Scania and Volvo from the automotive industry was because they gave immediate and positive response when they were requested to provide the information necessary for preparing the case-studies. Moreover, proximity and easy access to the people have also influenced the choice of the locus of the study. The authors also found out to be appropriate to collect data from Swedish companies as it is convenient to have contacts with the interviewees both personally and electronically.

The Case of Scania in Mexico

The Historical Development of the Establishment Processes

Scania was founded in 1891 in Sweden and up till now it has built and supplied more than 1,000,000 trucks and buses for heavy transport work to different parts of the world. The net sales of the company in 2006, i.e. from vehicles and services was 70,738 million SEK and the net sales from October 06 - September 07 amounted to 78,954 million SEK which is an increase of about 12 % in 12 months period. Scania has an integrated product concept that combines vehicles, service related products and financing. Specifically, it develops, manufactures, markets and sells trucks, buses and coaches, and industrial & marine engines. The company has production facilities in Europe and Latin America and assembly plants in ten countries in Africa, Asia and Europe. Scania has about 130 wholly-owned companies operating in the international market and out of total 34,000 around 12,000 employees are working in Sweden. Up till 95 % of its production is sold abroad and the rest 5 % in the domestic market.

The case of Scania in Mexico covers the time period from 1991 up till the present, i.e. 2007 and deals with the phenomenon of the establishment process. In one year time, i.e. until 1992 Scania sold 600 buses which were imported from the Scania subsidiary in Brazil, which is the regional, headquarter in Latin America. Until 1994 it was represented with a distributor that imported trucks and buses from Brazil. Thereafter, the board of directors decided to expand
its operations in Mexico and opened the fully owned sales and service subsidiary. Mr. Ulf Greveismuhl was appointed to be in charge of implementing the project to operate with the fully owned subsidiary. The reason for initiating this project was due to the fact that Mexico is the third world’s largest market after USA and Brazil.

Ulf Greveismuhl gained the right experience by working in several Scania offices in Sweden, Angola and Brazil since the 1970. His main duty was to learn the Mexican market, i.e. to find out how the trucks and buses look like and the technical specification of the Mexican market. Moreover, he had to find out in which segment Scania trucks and buses are suitable and established sales and service networks. At present Scania has about 15 service centres. The sales figure forecasted for the year 2007 is buses 300 units and Tucks 150 units. Regarding the changes that have taken place in the market share and number of customers from 2005 to 2007, Scania is said to have still a leading position in the bus sector and no changes have taken place. Whereas in the truck sector, its market share has declined as the customers are buying the right American products. The reason why the customers are buying American rather than Scania truck is due to the fact that Scania doesn’t have the right products for the customers. The American market is the most competitive after Mexico and Chile.

The fully owned sales and service company is called Scania de Mexico SA de CV, with offices in Mexico City. A factory, i.e. an assembling unit and five fully owned dealers located in San Louis Potosi (SLP). The dealers’ network is complemented with eight local distributors. Scania started to operate officially in March, 1995 when it inaugurated a fully owned factory (assembly plant) in San Louis Potosi (SLP), which employs about fifty people. Both buses and trucks are produced in this factory. The distribution office was opened in March, 1995 in Mexico City. The main duties of the distributors are to organize and support some ten independent dealers specifically in the field of sales and services of Scania products. Until 2005, the factory, i.e. the assembling unit, was located in San Louis Potosi (SLP) and the central office was located in Mexico City. Recently both the factory and the central office, i.e. commercial operations, are moved to Queretaro City. The changes are done in order to centralize the operations in, i.e. the commercial and industrial operations in Queretaro City and to reduce costs. Scania did not forecast any kind of growth in market share or number of customers when it took such measures. However, the strategy is to maintain small activity/presence in the market but profitable. Actually due to high demand for heavy vehicles in Europe, Asia and South America, Scania is prioritizing these other markets where the brand is highly recognized by the customers.

### The Market Structure in Mexico

The Mexican market is one of the most competitive in the world where almost all auto manufacturers have representatives. Mexico, Chile and Australia are the markets where you can find most of the bus and truck manufacturers. All European, American and Japanese auto manufacturers are operating in those markets. Scania operates in two markets in Mexico, i.e. in the truck and the bus market. The truck market is very unstable where a lot of very well established companies and is completely dominated by the American companies. The bus segment is extremely professional and profitable. The bus segment is European oriented and acts without any synergy with the truck segment, i.e. there are no common points or relationship among the two segments. In the truck segment, Kenworth has 60 (51.5) %, International 15 (14.4) %, Greightliner 15 %, Volvo USA 8 (8.6) % and Scania has 2 (1.9) % market shares. However, the bus market is dominated by the European firms. Volvo has 35 (34.1) %, Scania 25 (23.2) %, Daimler Chrysler 25 (30.4) %, MAN 5 (6.4) % and the local companies MCI and OISA have 10 % market shares. Scania is a significant supplier in the bus market. It was a market leader some years ago, i.e. before it lost its market leadership position to Volvo which has about 10 % higher market at present.

6) There are differences among the parenthesized and unparenthesized market shares and that is due to the fact that the information provided by the two interviewees differed to some extent. However, even if the figures differed to some extent the gap doesn’t change the position of the various auto producers.
**Customers**

The number of customers is more or less stable and the market share is showing some small growth mainly in the truck segment. The main customer is the bus company called ADO which bought about 600 buses up till 2006. Scania is the second largest supplier in the bus coaches segment. Generally, the customers are big and if they buy many buses from one customer, it will result in a good market position for the supplier. The second largest customer is a bus company called Estrella Blanca which already purchased around 300 Scania buses. The third largest customer is also a bus company called Flecha Amarilla which has already bought 180 Scania buses.

In general, the customers are satisfied with the Scania’s products and services as their needs are fulfilled. Most of the time, the customers buy standard products, but sometimes they claim different kind of power engines as those offered in Europe. According to Scania customers have more power in the relationship. Scania has very good products and services and it offers trucks, spare parts, services, maintenance and repairs to enable its customers in their turn provide good services to their customers to make profitable operations. Normally, it is the local distributor who directly contacts customers as the idea is to live very close to the customers. The distributor coordinates the contacts with the factory and the distribution of spare parts. Moreover, distributors are responsible for technical and sales training. All customers’ orders go via distributors to the factory. Then, the factory produces the buses and distributes them through dealers. Moreover, the dealers do provide services and deal with the customer relationship. The customers pay in cash for their purchases in time and as they are financed by the bank, payment is not a problem.

In the bus segment, the customers are buying products and parts and they are responsible for the necessary services. However in the truck segment Scania sells a complete solution, i.e. trucks, parts and services. Most of the time customers in both segments do buy standard products. The level of trust with the Scania’s customers differs in the two segments. In the bus segment, the relationship with customers is dominated by cooperation and trust, whereas in the truck segment it does not as the market has more trust in other brands than in Scania’s products and services.

**The Suppliers of Scania Mexico Factory**

The components used in the factory are produced both in Europe and South America, out of which 60% in Europe. The source of engines and cabs is Brazil and of the gear boxes is Argentina. Scania doesn’t have local suppliers and as the European companies have subsidiaries in different parts of the world it can be said that the Mexican factory has a global sources of components. It has also one US supplier of fuel injection system, i.e. Scania Commins. The complete kit of products is delivered from Brazil, Argentina, Europe and the US and the plant in Mexico is just assembling the vehicles.

**The General Mexican Environment**

The use of big cabs has become a typical American culture in the truck market, as those cabs have been used for a long time. This is called the old cabs concept and the same concept is used in the power train supply. It was very difficult for Scania to break this concept and to introduce the advanced cabs concept. Except in the US, Mexican and Chilean markets wherever you go, you will find the European trucks/cabs. In Europe there is a regulation of how long (large) the trucks should be, i.e. the complete combination. Accordingly, you have to have a short cab incorporated in the total length of the truck which is 16-18 meters long. Whereas in the US, they have other measurement systems and the length of the cab doesn’t matter. That is the tradition which the US producers are used to and which the American market demands/prefers. However, the European truck producers are not used to such a tradition and they find it difficult to fulfil the needs of the Mexican customers. Scania did not make this adaptation as its sales are too small to justify the adaptations to be done. To handle this problem, it is putting more focus in the bus segment and considers the truck market as a potential for the future. The bus is quite different and they look more or less the same all over the world.

The environmental legislation was not defined complete-
ly in 2005 and there was some pressure to adopt the North American Legislation (EPA) and this could create a constraint for Scania. The EURO engines were acceptable; however as EPA was still under discussion there was no regulation accepted on this issue. However, if the EURO engines were rejected Scania could be obliged to adapt its engines to the EPA.

In Mexico, there is a pollution emission regulation. Europe has another standard, and with the exception of Taiwan and Korea, Scania uses the Emission Engine in all other markets. However, in Mexico, to fulfil to EPA, Scania had to make certain adaptations to the EPA if the EURO was rejected. It is another test cycle, in contrast, to the European approval test method/ regulation. (as from 2006, Mexico is accepting EPA and EURO and there are no restrictions in terms of legislations to Scania’s products and from that date onwards there is no need for Scania to make adaptation of its products.)

Scania’s all competitors are offering credit to their customers through their own finance companies. However, Scania, on the first hand, has not offered this kind of financial service (captive finance company). It has to some extent agreements with local banks to offer some financial solutions. But, even in this regard the banks are doing the financial services without any Scania participation.

**The Case of Volvo in Mexico**

**Introduction**

Being one of the leading suppliers of commercial transport solutions, the Volvo Group provides products such as trucks, buses, construction equipment, drive systems for marine and industrial applications as well as aircraft engine components. Moreover, the group also offers to its customers’ financial services. Volvo has about 83,000 employees, sales activities in some 180 countries and production facilities in 18 countries. Sales of the Volvo Group increased by 7% to 248 billion SEK, with earnings per share increasing by 25% to 40.20 SEK in 2006.

The case of Volvo in Mexico covers the period from 1994 up till the present, i.e. 2007 and deals with the phenomenon of the establishment process. Volvo Trucks de Mexico as a subsidiary of AB Volvo is an independent company from other business areas or units that currently are represented in Mexico. The business areas in Mexico are: Volvo Trucks, Volvo Buses, Volvo Construction Company and Volvo Financial Services and the only business unit is Volvo Parts de Mexico. All business areas work independently and report to Sweden directly. However, they can work together for group purposes. For example, if the Swedish embassy in Mexico requires support from the Swedish companies, they act as a group and are represented just as Volvo. There are also other specific forms of cooperation among the various Volvo business areas. Specifically, Volvo Buses and Volvo Trucks work together for trade shows when buses and trucks are required to be exhibited.

**The Historical Development of the Establishment Processes in Mexico**

Volvo has a fully owned office which doesn’t carry out any local production. It just sells imported products in the local market. Volvo started to operate in Mexico in 1994 following the initiative taken by Volvo Trucks in North America (VTNA), which had a commercial agreement with Trailers de Monterrey. The agreement between VTNA and Trailers de Monterrey was signed more than a decade ago. As there were no Volvo Trucks corporate offices in Mexico by that time, Trailers de Monterrey was in charge of imports of the vehicles produced by VTNA.

In March 1994, Volvo Trucks de Mexico was established to do all the Mexican commercial operations of the vehicles produced in New River Valley and since then Trailers de Monterrey has no agreement either with VTNA or with Volvo Trucks de Mexico. There is a dealer network developed mainly for the purpose of sales, which is composed of 21 dealers and nine service points.

**The Structure of the Market**

There are three other major suppliers with larger market shares than Volvo operating in the truck segment. They are Kenworth (KW), Mercedes Benz (MB), and International. KW is the biggest supplier with about 50% market share.
and its main competitive advantage is pricing. MB belongs to Daimler Chrysler Group and being the second largest supplier has 25 % market share. Its competitive advantage is advanced technology and pricing. A multinational American firm belongs to the group of Navistar-International with 17 % market share and its main competitive advantage is pricing. Volvo Trucks has about 10 % market share and competes mainly with its advanced technology and safety, its prices being higher than the other suppliers. However, the bus market is dominated by the European firms. Volvo has 35 (34.1) %, Scania 25 (23.2) %, Daimler Chrysler 25 (30.4) %, MAN 5 (6.4) % and the local companies MCI and OISA have 10 % market shares. Recently, i.e. after 2005, several Asian auto makers such as Isuzu, Hino and Chinese car makers have entered the Mexican market intensifying further competition.

Volvo has increased its sales in the truck sector by 43 % in 2007 versus 2006 and by 69 % compared to 2005. One of the main reasons for the growth of sales is that Volvo has broadened its product range for the Mexican market introducing the VNM model produced in North America as well as Mack truck MR model. Moreover, Volvo has broadened its transport solutions to its customers, that is to say, availability of critical parts in the dealer network, new maintenance programs, engines software for downloading information on engine performance.

Customer Relations

Pricing is a disadvantage in a country where the economy is neither growing nor stable and that creates a problem for Volvo in the management of customer relations. However, it is trying its best to change its customers’ minds to make them realize that its higher price is a consequence of its investment in research and technology that concern its trucks. This will finally mean that they will get a return in their investment, i.e. through increased revenue when working with its products and services. Moreover, it is strengthening its dealer network with training, new financing and selling programs for both new vehicles, used trucks and parts, so that they will be in a position to offer an integrated services to their customers.

The General Environment

As the EPA and the Euro were not validated until 2007 by the Mexican legislation that created a sort of uncertainty for Volvo. This created inconveniences as it can affect the industry in which Volvo operates. Until 1997, there was a pending regulation to be established by the environmental authorities regarding the use of American or European engines. As far as the regulation goes, both engines comply with all environmental requirements, however, there was a commercial issue among the vehicles producers and the group has been divided into two. One group formed by Volvo Trucks, Volvo Buses, Kenworth, Cummins, Scania and others that support the idea that both kinds of engines should be accepted so that customers can have more opportunities and choices for their vehicles. The other group formed mainly by International and Daimler Chrysler group which support the idea that just American engines should be allowed in the Mexican market.

In this particular case, the legislation can cause that some investments to sell new products in Mexico are delayed or cancelled depending on the final resolution and that is why Volvo Group has products that are produced with European and American engines. Thus, the government decision will affect the operations and position of Volvo. Since the very beginning of this issue (situation), Volvo has actively participated in several meetings with the both environmental authorities and government officers as well as other governmental institutions to prove that both engines should be authorized. Even the Swedish Ambassador in Mexico has been involved in the whole issue. These efforts have paid-off and a new emission regulation for diesel engines - Norm 44 is proclaimed and accordingly as from July 1, 2008, all engines must comply with EPA4 or Euro4.

Analysis

Both Volvo and Scania were represented in Mexico by third parties in the early phases of their establishments. Consequently, they didn’t have direct relationships with the customers and that made it less probable to fully comprehend and
satisfy customer needs, a scenario that makes developing a strong position in the market less successful. This could also be a major hinder for both companies to develop a well functioning network of relationships. In other words, in the third party operations phase neither penetrating the existing Mexican industrial network nor building new supporting relationships to develop a market position was possible and it is why the establishment attempts were not successful. The establishment initiative in the case of Scania was taken by its board of directors and that of Volvo by VTNA. The two cases show how and to what extent both the head office and the regional offices are involved in new foreign market establishments. Three main reasons can explain the involvement of those actors; first, being the size of the market second, the presence of almost all major auto manufacturers and their networks which makes it easier to learn on how they work and to develop contacts and third, to understand and to serve the customers and the market better. The Scania head office and the VTNA can acquire knowledge about the market from their well established networks and contacts in the international market. In sum, both Volvo and Scania were well knowledgeable about the size of the Mexican market and the existence of well developed industrial networks in both the bus and truck sector and it is this knowledge that made them take the establishment initiatives.

Followed by advanced technology, pricing is found to be a major competitive tool in the market and specifically in the truck segment. In addition to the above, pricing combined with advanced technology have also enabled the three major actors in the market to develop strong customer relationships and to enjoy a leading market position in this segment. In other words, those firms have developed a strong-well functioning networks and strong customer relationships that enabled them to develop a strong position in this sector of the market. Volvo and Scania could not press their prices to the same level as that of their competitors and to use pricing as a competitive tool among other things due to their inability to develop a proper network in the truck sector. This is also a constraint at the same time for both firms in the management of customer relationships and the development of properly functioning networks. Consequently, they could not enjoy large market shares in the truck segment as they do in the bus segment of the market. Especially, Volvo is trying to change the attitudes of the customers instead of developing appropriate mechanisms and strategies in order to reduce its costs. Changing the attitudes of customers means to make them understand that the higher prices they pay the better quality of the products which makes their operation profitable in the long range. The significant role which pricing plays in the market is also in contrast to the already established role of pricing in industrial markets.

The old cabs concept is one cultural factor which enabled the US producers to produce trucks that meet the needs of the American and Latin American markets and to develop a competitive advantage over the European firms. Scania and Volvo are at a disadvantage in this regard because due to the market size constraint, they couldn’t make the necessary investments to adapt their products to fulfil customer needs. This aspect of culture has caused the European firms to loose competitive advantage. One way of managing this cultural problem could be, by developing an alliance among Volvo and Scania, a relationship that can help both firms to increase their market share and thereafter to make a justifiable product adaptation in order to solve the cultural problem. This dyadic relationship among Volvo and Scania can help them to build successful customer relationships and the broader network of relationships as a means of developing a strong position in the truck segment and a successful market establishment.

The EPA is also another factor in the environment that the International and the Daimler Chrysler group use to strengthen their position in the market. The European firms on their part took some measures in collaboration with Kenworth and Cummins to secure and strengthen their position in the market. Both groups are engaged in strong lobbying activities by attempting to develop strong relationships with the various authorities. They both present their cases in a way that can convince the concerned authorities to make a decision that favours their position. This clearly shows how important it is to develop a strong network with the authorities to be successful in the market. A proper and successful management of the authorities’ relationships can enable the firms to get their needs fulfilled which can create the possibilities of developing properly functioning cus-
Thematic Issues | Scania | Volvo
--- | --- | ---
Sectors the firms operate in | Truck and bus sectors | Truck and bus sectors
Market structure | Truck sector highly competitive, unstable, Americans oriented & dominated bus sector highly competitive, extremely professional & profitable, European oriented & dominated | Truck sector highly competitive, unstable, Americans oriented & dominated bus sector highly competitive, extremely professional & profitable, European oriented & dominated
Network structures | Both the truck & bus sectors are tightly and well-structured | Both the truck & bus sectors are tightly and well-structured
Third party operations | Didn’t succeed to get established in the truck and bus sector | Didn’t succeed to get established in the truck and bus sector
Why third party operations failed | Couldn’t really comprehend and satisfy customer needs and to build market networks and positions | Couldn’t really comprehend and satisfy customer needs and to build market networks and positions
Operations through | Assembling & sales subsidiary | Sales subsidiary
Market position | Strong in the bus sector which is European-oriented, weak in the truck sector | Strongest in the bus sector, fourth in the truck sector which is American-oriented
Competitive advantages in developing successful customer relations in the bus sector | Complete solution which includes truck, parts and services. Cooperation with some competitors and strong relations with authorities | Strong dealers network strengthened through complete solution including training, new financing and selling programs, i.e. offering integrated services. Cooperation with some competitors & strong relations with authorities.
Competitive disadvantages to develop strong and large customer relations in the truck sector | Pricing, Inability to adapt to the old cabs culture in the truck sector | Pricing, Inability to adapt to the old cabs culture and to the EPA. Customers trust other brands in the truck sector
Measures to deal with competitive disadvantages | Provides complete solution which includes truck, parts and services | Trying to change customers attitudes to believe that higher prices will pay in the long range in terms of ROI
Competitive nature of the market | Makes the firm to develop strong relations with some competitors and with authorities | Makes the firm to develop strong relations with some competitors and with authorities
Customer satisfaction | Strong in bus sector and weak in truck sector | Very strong in bus sector and semi-strong in truck sector
Challenges | Difficult to penetrate the truck sector network | Difficult to be dominant in the truck sector network
Cultural barrier | Difficult to break the old cabs concept & limited success to introduce advanced cabs concept | Difficult to break the old cabs concept & to the EPA. Customers trust other brands in the truck sector
Environmental factor | EPA makes it difficult to penetrate the truck sector network | EPA limits consolidating position in the truck sector network
Environmental factor | Both EPA and Euro accepted reducing the impact of the environmental regulations | Euro & EPA acceptance reduced impact of the environmental regulations
Adaptations | Difficult in the truck sector network, whereas bus are standard products | Difficult in the truck sector network, whereas buses are standard products
Establishment attempts | Competitive advantages helped to achieve success in the bus sector and competitive disadvantages resulted in less success in the truck sector | Competitive advantages helped to achieve very high success in the bus sector and quite successful in the truck sector
Authority relationships | Significant resource in establishments | Significant resource in establishments

The highly competitive nature of the market has also created two groups of firms that collaborate within their groups in order to be able to strengthen their competitive power against the other group. Both groups are acting in almost the same way to beat their competitors by strengthening the relationships among the firms in their group. Cooperative relationships are built among some competitor firms in order to develop a strong position in the market that weakens the position of the other competitor firms.
Conclusions

The first conclusion from this article is that developing a strong position or getting established in the Mexican industrial networks without a direct relationship with the customers, i.e. by being represented with third parties only, is the difficult and time consuming process. This clearly demonstrates and enables us to conclude that third party relationships are inappropriate or less successful means of market establishments in the Mexican market. The second conclusion is that the Mexican bus segment is European oriented and the truck segment is American oriented. This being the contrast there are also similarities among the two markets and that is both in the bus and truck segments, there are well developed and tightly structured industrial networks which function more or less in the same as the networks in developed countries, although Mexico is a developing country. This is mainly due to the fact that the Mexican industrial market is highly internationalized and industrialized because Mexico, Chile and Australia are the countries where you can find most of the auto manufacturers. Specifically in Mexico all European, American and Japanese auto manufacturers have physical presence and are operating there. The third conclusion, that can be drawn from this article, is that the differences in the orientation among the truck and bus sectors created both opportunities and constraints for the American and European firms. That is to say the European-orientation of the bus sector created an opportunity for the European firms to build a successful market establishment and a properly functioning network and at the same time it created a constraint for the American firms. Whereas, the American-orientation of the truck sector created an opportunity for the American firms to build a successful market establishment and a properly functioning network and at the same time it created a constraint for the European firms. In contrast, to earlier findings in the studies of industrial markets, pricing in the Mexican industrial market is found out to be one of the major competitive tools for developing and sustaining a strong market position. It can also be concluded that, to achieve success in the Mexican automotive industry firms have to manage the old cabs concept adequately, otherwise it is difficult to satisfy customer needs and to develop adequate customers’ relationships and to build a stable position in the market with a reasonable market share. Firms have to adapt their products taking this cultural issue into consideration and this shows the impact of cultural on the success of the establishment process. The other conclusion to be drawn from this article is in connection with government relationships. Developing strong relationships with the various authorities can help firms to get a certain act adopted that can enable them to create a competitive edge that weakens the position of their rivals in the market. It can even be further concluded that managing government relationships properly creates an opportunity for building supporting relationships to develop properly functioning customer relationships and the surrounding network of relationships. Finally, cooperative-competition is observed to be a good strategy in this market as it can help firms to strengthen their position and to bit their rivals. Cooperative-competition means to cooperate with some of your competitors in order to strengthen your competitive edge and to compete with the rest of the competitors operating in the market. A firm, instead of competing with all firms operating in the market, cooperates with some of them and competes with the rest to create stronger position.

Managerial Implications

The first management implication that can be done from this article is that physical presence and direct contacts, with the customers, without involving third parties, with the exception of some rare cases, are two important issues that have to be dealt with properly. Moreover, as the firms operating in the automotive industry have well established international connections and networks, in order to achieve their objectives firms that aim to get established in the Mexican market have to have international connections or have to develop a JV or strategic alliances with firms which have well established international networks. Management of firms that operate in the Mexican market and especially in the truck segment, have to take appropri-
ate measures in order to be able to bridge the cultural gap that can be created by the old cabs concept, otherwise their investments are risky and they can easily be swallowed by their competitors. The other implication for management is that it is necessary to assess the orientation of the market in question and whether it matches the company’s products and mode of operations as market orientation can be different in different markets. This is important because there are wide chances for success in the company’s establishment attempts. If the market orientation matches the companies products and mode of operations. This article also implies that Mexican market establishment can be carried out successfully either by penetrating the existing network as there are well developed market networks or by creating supporting relationships and developing a new network for the firms position in the market. Not only satisfying customers’ needs, but dealing with the various government authorities adequately is also one of the preconditions for success in the Mexican market. It is recommended here that firms should comply and lobby in accordance with the environmental regulations. If flaws are identified in the environmental regulations, management should present convincing evidence (argument) to the concerned authority in order to change the regulations and to facilitate its operations in an ethical manner. In other words, company interests should comply and take into consideration, what is good for the environment and the society, otherwise it will have the negative impact in the environment in the long run and all involved actors including the company, the government, and customers and by and large the society will loose. What management should consider being another typical characteristic about the Mexican market is that pricing is also found out to be a strong competitive tool in contrast to other markets. The final managerial implication that can be done from this article is that firms should not compete indiscriminately with all actors in the market, but they have to make a proper selection and cooperate with some of them in order to strengthen their competitive edge and to succeed in their competition with the rest which operate in the market.

REFERENCES


[한국어 요약(Korean Abstract)]

본 연구는 멕시코에 진출한 두 스테디 완성차업체, 스카니야와 볼보의 공장 건설 프로세스 모델 (establishment process model)의 적용 방법을 분석한 것이다. 멕시코 자동차시장의 구조와 법률, 정치, 문화, 재정 측면이 어떻게 외국 업체의 멕시코 진출에 영향을 미쳤는지에 대해 분석하였다.

아울러 조사 방법으로 탐색적 연구가 진행되었고 상호작용적 접근(interaction approach), 신경망 구조 접근(neural network approach) 등이 다양하게 적용되었다. 상호작용적 접근법은 산업 환경과의 상호작용, 관계자들과 상호작용 프로세스 등의 변수를 고려하여 판매가 구매자 사이의 상호작용을 설명하는 방식이다. 이번 연구는 사실에 근거하여 기술한 탐색적 사례 연구이다. 국제경영, 전략, 관리, 마케팅에서 구조화한 발전한 방법론과 더불어 제조업체에서 국제경영 성과를 측정하는 통계적인 방법과 기준을 적용하였다.

연구 결과를 정리하면 다음과 같다.

첫째, 비록 멕시코가 개방도상국이기는 하나 버스와 트럭 시장에 있어서는 선진국에 못지 않은 단단한 구조적인 판매 및 서비스 네트워크를 이루고 있다. 멕시코는 매우 경쟁적인 자동차시장으로 세계 유수의 자동차 업체들 대부분이 판매 대리인(representative)을 두고 있는데, 특히 버스시장은 매우 전문적이고 많은 이익을 창출하고 있어 트럭 및 다른 차종과는 상이한 구조를 이루고 있다. 다시 말해, 버스와 트럭시장 사이에는 상호 시너지효과가 없는 것으로 나타났다. 버스시장은 주로 유럽 업체를 중심으로, 트럭은 미국 업체를 중심으로 형성되어 있다.

둘째, 스카니야의 고객 신뢰도 수준이 트럭과 버스 두 세그먼트에서 서로 다르게 나타나고 있다. 즉, 트럭에 대한 고객 신뢰도가 특히 크게 나타나고 있으며 타 브랜드에 비해서도 높은 신뢰도를 유지하고 있었다. 이러한 높은 신뢰도는 스카니야의 우수한 상품력(품질)과 완벽한 서비스(비품 수급, 정비, 교육 등) 솔루션을 기반으로 하고 있다. 버스의 경우에는 트럭과 달리 고객과의 관계가 보다 유연하다. 즉, 전적인 지원보다는 고객과의 협조 체제로 서비스가 이루어지고 있다.

셋째, 스카니아의 경쟁력은 상품력과 서비스뿐만 아니라 경쟁사와의 협력적 경쟁관계(cooperative-competition) 및 당국과의 강한 유대관계로 이루어진 뛰어난 시스템을 토대로 하고 있다. 여기서, 협동적 경쟁관계란 자가 부족한 부분을 경쟁업체와 협력하는 반면 나머지 부분에서 경쟁력을 키워 차별화하는 것을 일컫는다. 협력적 경쟁관계는 자사의 경쟁적 지위를 효과적으로 유지시킬 수 있는 좋은 전략으로 판명되어 있다. 멕시코 시장에서 기업의 정부와의 관계, 즉 환경규제법 등 관계법규를 준수하고 적절한 로비활동을 하는 것은 고객과의 관계만큼 중요하다. 특히 외국기업이 멕시코 현지에서 사업을 추진하기 위해서는 이 부분에 관한 철저한 대처가 필요하다.

마지막으로, 볼보의 경쟁 우위는 달러 교육, 다양한 금융조건을 이용한 판매 조건을 통하여 딜러들과의 강한 네트워크에 기반하고 있다. 그 밖에 우수한 서비스, 협력적 경쟁관계 및 관계 당국과의 강한 유대관계는 스카니야의 경쟁력과 유사하다.
Moderating Effects of Environmental Uncertainty on Supply Chain Integration and Product Quality: An Empirical Study of Thai Automotive Industry

Abstract - Although effective and efficient supply chain management requires integrated business processes that go beyond purchasing and logistics activities, some doubts are expressed concerning the applicability of supply chain integration practices. Specifically, a careful literature search reveals that no studies have included the effect of environmental uncertainty on the relationship between supply chain integration and product quality. This study, therefore, represents an attempt to provide the contribution in the field by developing a model to explore the relationships and to fulfill the gap between the literature on supply chain integration and environmental uncertainty. The findings indicate that the effects of supply chain integration on product quality are moderated by environmental uncertainty as demonstrated by Chow tests. The results also provide managerial insights about environmental uncertainty-supply chain integration practices connection.

Keywords - Supply chain integration, Environmental uncertainty, Automotive industry, Thailand

In an increasingly competitive global marketplace, most firms are competing with a high level of market pressure worldwide. In the context of supply chain management, it is necessary for industry to develop supply chain networks of activities involved in producing and delivering a final product from suppliers to end customers. However, effective and efficient supply chain management requires integrated business processes that go beyond purchasing and logistics activities. By integrating closely with suppliers and customers, firms can improve product quality in order to remain competitive. While supply chain integration is definitely crucial for supply chain management, some doubts are expressed concerning the applicability of supply chain integration practices. In particular, the literature in supply chain management pays little attention to environmental uncertainty-supply chain integration practices connection. Specifically, a careful literature search reveals that no studies have included the effect of environmental uncertainty on the relationship between supply chain integration and firm competitive capability, especially product quality. van Donk and van der Vaart (2005) also states that different
aspects of supply chain integration might be important under different circumstances. Hence, there is still a need for more research to investigate the effect of environmental uncertainty on the relationships between supply chain integration practices and product quality. Further empirical analysis seems necessary to investigate the relationship between environmental uncertainty as a contingency factor in determining supply chain integration structure and firm performance.

This study emphasizes that the contingency factor as the environmental uncertainty is important to the effect of supply chain integration on product quality. This paper posits the following research question: To what extent does the environmental uncertainty moderate the relationship between supply chain integration and product quality? This study, therefore, represents an attempt to provide the contribution in the field by developing a model to explore the relationships and to fulfill the gap between the literature on supply chain integration and environmental uncertainty; since there has been little research recognizing the value of the effect of uncertainty on the relationship between supply chain integration and product quality. As a result, it takes the next step to understand how management of supply chain integration is performed under various circumstances.

**Literature Review**

**Supply Chain Integration**

The development of supply chain integration includes three stages from strategic to tactical and then to operational perspectives (Steven 1989). Strategic perspective establishes a framework for the supply chain in terms of what the supply chain has to do well, and ensures a support to the business. Tactical perspective involves the means by which the strategic objectives can be realized and translated into goals and objectives for each function in the supply chain. Moreover, the tactical perspective includes the tools related to organizational structure, technologies, systems, and infrastructure. Operational perspective represents the efficient operation of the supply chain. Steven (1989) also classifies supply chain integration into three levels from functional integration, to internal integration, and to external integration. However, this study focuses only on internal and external integration because the functional integration is claimed as a basic requirement that all firms should implement and achieve.

1) **Internal integration**

To best support customer requirements at the lowest total system cost, internal integration represents the integration of all internal functions from material management to production, sale, and distribution (Morash et al. 1997). At this stage, the firm focuses not only on the internal flow of goods into the organization, but also on the way out to the customer. Moreover, the internal integration is characterized by full systems visibility from distribution to purchasing, and required integration across functions under the control of the firm to achieve customer satisfaction. In practice, it means that special attention must be given to the interface between functional areas such as procurement, production, logistics, marketing, sales, and distribution (Steven 1989; Morash et al. 1997).

2) **External integration**

In terms of customer integration, the firm will penetrate deep into the customer organization to understand the product, culture, market, and organization so that it can respond rapidly to the customer’s needs and requirements. The important concept of customer integration is based on the improvement of demand planning and visibility in supply chains (Fisher et al. 1994). Without information sharing from one end of the supply chain to the other, it can lead to tremendous inefficiencies in customer service. Many studies have considered the classification of customer-side integration in various dimensions. For instance, Frohlich and Westbrook (2001) evaluate customer integration using the following issues: 1) efficient delivery, 2) delivery/logistics communication, 3) speed of delivery/route, 4) inventory stocking points, and 5) demand planning.

For the supply integration, integration back down to the
suppliers represents a change in attitude, away from conflict to cooperation starting from product development, supply high quality products, process and specification change information, technology exchange, and design support. Some researchers have investigated the supply-side integration in different dimensions. Handfield (1993) defines supply integration as obtaining frequent deliveries in small lots, using single or dual sources of supply, evaluating alternative sources on the basis of quality and delivery instead of price, and establishing long-term contracts with suppliers. In terms of logistics communication, Ragatz et al. (2002) view supply integration as the effective alignment, information sharing, and supplier participation between suppliers and manufacturers.

3) Environmental uncertainty

Environmental uncertainty has been defined on the basis of the concept of uncertainty. Duncan (1972) views that uncertainty can consist of the following three components: 1) the lack of information regarding the environmental factors associated with a given decision-making situation, 2) not knowing the outcome of a specific decision in terms of how much the organization would lose if the decision were incorrect, and 3) inability to assign probabilities with any degree of confidence as to how environmental factors are going to affect the success or failure of the decision unit in performing its function. According to Lenz (1980), environmental uncertainty can be defined as the source of events and changing trends that create opportunities and threats for individual organizations. As Ettlie and Reza (1992) point out, environmental uncertainty can also be viewed as unexpected changes of customers, suppliers, competitors, and technology. The same classification of environmental uncertainty is adopted in Li et al.’s (2005) study of integrated model for supply chain management. Consistent with this perspective, this study considers environmental uncertainty as the perspective of uncertainty on customers, suppliers, competitors, and technology. This framework represents the core concept of environmental uncertainty, and allows identifying and analyzing the influence of uncertainty in supply chain management practice.

Customer uncertainty is defined as the extent of change and unpredictability of customer’s needs and demands (Zhang et al. 2002). Faced with environmental uncertainty and increased competition, markets are becoming more international, dynamic, and customer driven. Customers are more sophisticated. They demand more variety, higher quality, and better product (Claycomb et al. 1999). It is becoming more important to develop new products effectively than to produce old product effectively. Being efficient is no longer enough, customers want better product with faster delivery. Geary et al (2002) state that customer uncertainty can be viewed as the difference between the actual end-marketplace demand and the orders placed with an organization by its customers. It can be measured in terms of how well companies meet customer demand. For instance, customers place orders twice the typical order size, resulting in poor on-time delivery or fill rate performance. Moreover, customer uncertainty can be defined as the link to the predictability of the demand for the product. For example, products which are characterized as high demand variability, difficult to forecast, irregular purchase, high innovative and short life cycle have highly customer uncertainty in terms of product options and volume (Chang 2002). In terms of product features, Garvin (1988) also points out that it is important for firms to offer more customized products to meet specific customer’s needs. Due to this customer pressure, the requirement for flexibility and mass customization that emphasizes flexibility and small batch production has been developed.

Supply uncertainty is defined as the extent of change and unpredictability of the suppliers’ design, quality and delivery performance. Uncertainty caused by suppliers, such as late delivery, machine broke down, quality of incoming material or parts, and degree of inconsistency will postpone or delay a manufacturing process. This uncertainty can lead to increasing inventory cost which could propagate throughout the whole network. Geary et al. (2002) consider supply uncertainty as the results from poorly performing suppliers not meeting organization’s needs. Supply uncertainty can also be evaluated by looking at supplier’s delivery performance, time series of order placed, actual lead-times, and supplier quality reports. Effective supply-based activities
can contribute to higher level in performance. For example, supplier involvement has a significant impact on return on assets (ROA) and growth (Tan et al. 1999). A manufacturer with poor performance supplier will find it very difficult to provide high levels of customer service. Lee (2002) points out that supply uncertainty can be viewed as evolving supply process where the manufacturing process and the underlying technology are still under early development and are rapidly changing. Consequently, suppliers may be limited in both size and experience. In evolving supply process, supply uncertainty can be evaluated as the dimensions including potential quality problem, unreliable suppliers, inflexibility or difficulty of changeover and variable lead time. Similarly, in the study of Chang et al. (2002), they construct supply uncertainty by considering the unpredictability degree of four factors including improvement of vendor quality as requested, possibility of increasing vendor production capacity, possibility of changing vendor delivery date, and possibility of vendor quality variation. In addition Li (2002) assesses supply uncertainty by providing factors such as unpredictability of engineering level, product quality, delivery time, and quantity.

Competitor uncertainty is defined as the extent and unpredictability of the competitors’ actions (Li 2002). Globalization and demanding customers increase the level of competency in business. Organizations that focus on domestic markets must be able to understand foreign rivals that penetrate their markets. As a result, firms have no choice but to develop global perspective of competition by recognizing the entry of new competitors and the necessity of partnership with other organizations. This competition is forcing firms to rearrange their business strategies away from conventional, cost-based strategies to knowing which feature a customer wants. Jones and Ryan (2002) suggest that firms cannot operate in such a static environment. Even in a stable market, business may be exposed to periodic "shocks" that can move a firm up to high competition. In the case of Caterpillar and Komatsu, two global companies in the construction equipment industry, Caterpillar operated in a stable environment until the 1980's. Then, Komatsu began taking over the market share by offering products with similar performance at a much lower price. For this reason, Caterpillar forced a movement towards more organic strategies. The literature has suggested how to operationalize competitor uncertainty. For example, Chang et al. (2002) suggest three factors regarding possibility and predictability of competitors changing: 1) price, 2) marketing strategies, and 3) entry/exit of new/current competitors. Similar to the Chang et al. (2002) study, Li (2002) provides the measurement including the possibility of competitors to introduce new product unexpectedly, enter form different sectors/countries, and unpredictable actions.

Technology uncertainty is defined as the extent of changes and unpredictability of product and process technology development. The development of technology provides numerous opportunities for organizations. For example, companies apply new technology to offer various products to take advantage of new opportunities. New market opportunities come with technological innovation. As technology becomes more multidisiplinary and dynamic, firms are relying on other firms as a way to attain the technological know-how necessary as parts of their supply chain restructuring programmes. Additionally, developments in information technology enable companies to achieve a degree of control in international supply chains. Advanced information technology can also reduce transaction costs relating to the control of goods flows and the making of a quick response to customer orders. Ragatz et al. (2002) suggest that technology uncertainty can be measured as the degree to which the product or process technologies employed are new, complex, and/or rapidly changing. In terms of product technology uncertainty, Chang et al. (2002) include two variables: 1) change of core production technology, and 2) change of supporting technology. Technology uncertainty can also be viewed as how significantly changing of technology in particular industry, and technology breakthrough resulting in new product development.

**Hypotheses Development**

**Environmental Uncertainty as a Moderating Effect**

The environmental uncertainty could influence the relation-
ship between supply chain integration and firm competitive capability. As suggested by Lee (2002), a product with a stable demand and a reliable source of supply should not be managed in the same way as one with a highly unpredictable demand and an unreliable source of supply. To further explain, automotive industry provides an appropriate example. It is expected that this industry with high level of supply uncertainty will affect the supply integration strategy on product quality performance more than other industries with low supply uncertainty. To support this assumption, Hrebiniak and Snow (1980) and Fisher (1997) indicate that uncertainty will vary by product sector or industry. Some uncertainty characteristics require supply chain strategies that can provide a competitive edge to companies. In addition, Stonebraker and Afifi (2004) suggest that different types and amount of supply chain integrative efforts are appropriate in different situations. Therefore, the effect of supply chain integration on product quality capability may indeed be different under various models, depending on environmental uncertainty. Therefore, the following hypotheses were proposed:

H1) Supply uncertainty has a moderating effect on the relationship between supply chain integration and product quality.

H2) Customer uncertainty has a moderating effect on the relationship between supply chain integration and product quality.

H3) Technology uncertainty has a moderating effect on the relationship between supply chain integration and product quality.

H4) Competitor uncertainty has a moderating effect on the relationship between supply chain integration and product quality.

Methodology

Survey Instrument and Data Collection
The instrument used to test the hypotheses was a mail survey. This study used five-point Likert scale for all constructs to draft a questionnaire. This draft questionnaire then was pre-tested with academics and practitioners to check its content validity and modified accordingly. The modified questionnaire was pilot-tested to examine its suitability for the target population before large-scale mailing.

Empirical data was obtained through a mail survey to production or purchasing managers, who had knowledge of supply chain management practices. These respondents were asked to rate their firms relative to their understanding on supply chain integration, environmental uncertainty, and product quality performance. The unit of analysis in this study was limited to plant level. Within this perspective, Flynn et al. (1994) point out that most empirical research in operations management occurs at the corporation or individual level of analysis. Moreover, the independent variables of supply chain management practices usually reflect corporate level practices. Similarly, the dependent variable of firm competitive capability also reflects the corporate level results.

The survey was selected specifically to automotive industry in Thailand because of the following reasons. First, automotive industry is seen as an indicator to measure the wealth of the economy. Second, the literature in automotive supply chain has been well documented in previous research, and there is a clear structure of automotive supply chain. Finally, automotive sector has been a leader in implementing supply chain management strategies in Thai industry. We forwarded the questionnaire with a cover letter indicating the purpose of this study to 403 qualified first-tier suppliers and automakers. After six weeks, we received 91 completed responses following 20 questionnaires returned as the second wave. The total 111 responses were returned to the response rate of 27.5%.

Non-Response Bias
In this study, non-response bias was evaluated using the method suggested by Armstrong and Overton (1977). This method tested for significant different between early and late respondents, with a late respondents being considered as a non-respondent. By using this method, although it did not investigate non-response directly, a comparison was made between those subjects who responded in the first
wave and the second wave (Larson and Poist 2004). A one-way analysis of variance (ANOVA) was used to make the comparisons in demographic variables, namely, number of employee, respondent’s position, and number of years in business. Along with the demographic variables, randomly selected variables were also included in this analysis. The results indicate no significant difference on any criteria, which the significant level, is far from 0.1. Based on the ANOVA test, non-response bias may not be the problem in this study and the two waves were pooled for subsequent analysis.

**Data Analysis**

**Instrument’s Validity and Reliability**

As new items were being used, an exploratory factor analysis (EFA) of the items in each constructed was conducted using a Varimax rotation to reduce the number of items. EFA is useful in discovering potential latent source of variance and covariance in observed measurement. Items with good measurement properties should show high factor loading on the factor of which they are indicators, while small factor loading on the factor that are measured by different sets of indicators. Therefore, this result can provide an evidence of initial construct validity.

In this sense, validity is defined as the extent to which the instrument captures what it is intended to capture. According to Nunnally (1978), to test the construct validity, the EFA is used to assess either inter- or intra-scale differences, and established by the following decision rules including: 1) minimum Eigenvalues of 1; 2) the value of 0.5 was used as the cutoff score for factor loading. In addition, the items with serious cross loading, which means the items loaded very close to 0.5 on more than one factor. In this study, factor loadings lower than 0.4 were removed in order to streamline the final result. In addition, the Kaiser-Mayer-Olkin (KMO) measure and Bartlett’s test of sphericity were tested to ensure that the data had inherent sufficient correlations to perform EFA. The KMO index was 0.80, and Bartlett’s test of sphericity was significant at a level of 0.00, which justified the use of EFA.

To begin, the factor structure of each scale for supply chain
integration, environmental uncertainty, and competitive capability was explored by conducting a factor analysis on each scale individually. For each the items loaded on only one factor, with total variance extracted exceeding 50 percent in all cases. The reliability of each scale, measured internal consistency using Cronbach’s alpha also was above the recommended threshold of 0.7 (Nunnally 1978). The EFA loading, Eigenvalue, percentage of variance explains, KMO index, Bartlett’s test of sphericity for all items are available at the Appendix A.

1) Supply chain integration
As the independent variables, the internal integration factor explained 66.3% of the variance with all its four items loading on a single factor with loading ranging between 0.716 and 0.857. The scale Cronbach’s alpha was 0.83. In addition, the factor of supply integration explained 72.2% of variance with all its three items loading ranging between 0.748 and 0.840. The scale Cronbach’s alpha was 0.808. Besides both internal and supply integration, the factor of customer integration explained 68.85% of variance with all its three items loading between 0.701 and 0.836. The Cronbach’s alpha of this factor was 0.765.

2) Environmental uncertainty
Based on results from factor analysis, there are four factors of types environmental uncertainty in this study. It can be seen that all items loaded on their respective dimensions, with most loading greater than 0.60. The cumulative variance explained by four dimensions is well in excess of 50%. In addition, the Cronbach’s alpha of supply uncertainty, customer uncertainty, competitor uncertainty, and technology uncertainty are 0.839, 0.767, 0.727, and 0.730 respectively.

3) Product quality
The dependent variable in this study is product quality performance. According to the same recommended value to test scale validity and reliability used in the previous constructs. The cumulative percentage of variance explained for product quality construct was well in excess of 50%, showing 71.87%. In addition, reliability was tested using Cronbach’s alpha for each factor. The reliabilities of product quality construct showed satisfactory scores, representing 0.899

Results and Discussion
This study focuses on the moderating effects of four contingency variables on product quality through three dimensions of supply chain integration. These four variables are: supply uncertainty, customer uncertainty, technology uncertainty, and competitor uncertainty. The Chow test has been often employed to test whether there is a structural change between two groups by examining the statistical significance of the difference in the size of regression coefficients (Chow 1960). Based on the previous studies in operations management research (e.g., Hope and Muhlemann 2001; Fynes and Voss 2002; Bstielet and Gross 2003; Fam and Yang 2006), these authors also use Chow test to examine the stability of the regression coefficient across two sub-groups. Thus, the Chow test is an appropriate methods to test if the above four variables have a moderating effect on firm competitive capability. All responses were divided into two groups based on each of four variables into high and low groups, which are below and above the composite means of the four contingency variables in order to assess the impact of supply chain integration on product quality using multiple regression analysis.

As presented in Table 1, F-statistics for technology uncertainty and competitor uncertainty were significant at 0.05 levels in the case of product quality. Specifically, the results show that firms which faced low technology uncertainty, internal integration positively impacted product quality. In contrast, for the sub-group of firms facing high technology uncertainty, supply integration was the primary factor to product quality. In the case of competitor uncertainty, only for firms reporting low uncertainty does supply integration predict product quality, while internal integration positively impact product quality for firms facing high competitor uncertainty. As the evidence shown in Chow tests, it is also noteworthy that supply uncertainty and customer uncertainty are not significantly different between two sub-groups of
environmental uncertainty variables. It appeared that only technology uncertainty and competitor uncertainty were significant contingency variables. Therefore, hypothesis 3 and 4 are supported.

An examination of the relationship between supply chain integration and product quality for firms reporting low and high environmental uncertainty yields the following results. Overall, this present study indicates that the effects of supply chain integration on product quality are moderated by environmental uncertainty as demonstrated by Chow tests. More specifically, only firms facing low technology uncertainty, internal integration and customer integration show a significant impact on product quality, while in a case of high technology uncertainty only supply integration shows a significant effect on product quality. An explanation for this finding lies in the action of firms when faced with high technology uncertainty may be more reluctant to integrate internally and collaborate to customers since technologies become obsolete quickly and new products are introduced frequently. Hence, the integrative business processes among departments and with customers should be less than when technology obsolescence is slow. Among firms reporting low competitor uncertainty, only supply integration predicts product quality, where as among firms facing high competitor uncertainty internal integration predicts product quality. It may imply that firms prefer not to integrate to their suppliers in a highly competitive environment. In contrast, decentralization or internal integration practices are needed to emphasize in order to survive in a highly competitive environment.

These moderating factors should be considered of potential interest to researchers and practitioners. Moreover, the results shed some light on the relative degrees of significance of the environmental uncertainty variables. This result is consistent with the results in previous studies (e.g., Zacharia and Mentzer 2004; Fynes et al. 2006). In Fynes et al.’s research (2005), the interaction between supply chain relationship quality and environmental uncertainty on supply chain performance is very significant.

However, the findings of this study contradict the idea that firms must develop supply chain integration practices to deal with high environment uncertainty (Buvik and John 2000). In contrast, for firms reporting high uncertainty, supply chain integration mostly does not impact product quality. The findings could be explained by the following arguments. First, effective implementation of supply chain integration practices especially in automotive industry will need the existence of commitment, shared visions among internal functions as well as suppliers and customers under stable business environment. In other words, the empirical results of this study demonstrate that obtaining favorable results in product quality is based on building the effective relationship with business partners under low environmental uncertainty. This finding supports the work of Morris and Carter (2005), who suggest that firms should invest their resources in both reducing uncertainty and increasing cooperation in their relational exchanges. Second, management in firms operating in high uncertainty may be more reluctant to integrate internally and externally to their business partners since those integrative supply chain practices under condition of low uncertainty may be viewed as more strategic than they are under conditions of high uncertainty. In other words, firms may emphasize their supply chain integration practices only on the condition of low uncertainty, but not prepare themselves for high uncertainty condition. As a result, it is not likely to see the significant relationship between supply chain integration and product quality under high environmental uncertainty.

The results of this study pinpoint an important implication for practitioners by highlighting the importance of environmental uncertainty in implementing supply chain integration. Although firms have tended to focus on integrative supply chain practices, they have not given enough attention to the effect of external factors such as environmental uncertainty. The results of this study demonstrate to the practitioners that to achieve high level of product quality through supply chain integration, spending time and effort understanding types of uncertainty before investing in supply chain integration is a must. The basic concept is that the implementation of supply chain integration is not rigid. Rather, a success is attributable to the way in which supply chain integration practices are combined and organized based on the uncertainty or business condition factors.
In terms of research contribution, the results obtained in this study empirically confirm that different business environments require different supply chain integration practices on firm competitive capability. If the supply chain integration strategy is inappropriate to the level of differentiation, it would be a reason for increased supply chain costs, and in the long run suggest potential failure (Stonebraker and Afifi 2004). In regards to implications for managers, firms need to choose the specific supply chain integration strategy on developing product quality under different circumstances. The results provide managerial insights about environmental uncertainty-supply chain integration practices connection.

REFERENCES


Jones, R.T. and Ryan, C. (2002). Matching Process Choice and


### Appendix A1

#### Constructs, Variables, Factor Analysis and Internal Consistency for Supply Chain Integration

<table>
<thead>
<tr>
<th>Internal Integration (II)</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>II1</td>
<td>0.733</td>
</tr>
<tr>
<td>II2</td>
<td>0.857</td>
</tr>
<tr>
<td>II3</td>
<td>0.716</td>
</tr>
<tr>
<td>II4</td>
<td>0.758</td>
</tr>
</tbody>
</table>

Percentage of variance = 66.3, Internal consistency ($\omega$) = 0.83

### Supply Integration (SI)

| SI1 | We share information to our suppliers through information technologies | Dropped |
| SI2 | We have a high degree of strategic partnership with our suppliers (i.e. single/dual sourcing of supply with long-term relationship) | Dropped |
| SI3 | Our plant has a high degree of joint planning to obtain rapid response ordering process (inbound) with our suppliers | 0.793 |
| SI4 | Our suppliers provide information to us in the production and procurement processes | 0.840 |
| SI5 | We obtain efficient and reliable delivery (inbound) from suppliers. | 0.748 |
| SI6 | Our suppliers are involved in our product development processes | Dropped |

Percentage of variance = 72.2, Internal consistency ($\omega$) = 0.808

### Customer Integration (CI)

| CI1 | We share information to our customers through information technologies | 0.701 |
| CI2 | Our plant has a high level of information sharing with our customers about market information | Dropped |
| CI3 | We have a high degree of joint planning and forecasting with our customers to anticipate demand visibility | Dropped |
| CI4 | Our customers provide information to us in the procurement and production processes | 0.785 |
| CI5 | Our customers are involved in our product development processes | 0.836 |

Percentage of variance = 68.85, Internal consistency ($\omega$) = 0.765

### Appendix A2

#### Constructs, Variables, Factor Analysis and Internal Consistency for Environment Uncertainty

<table>
<thead>
<tr>
<th>Supply Uncertainty (SU)</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>SU1</td>
<td>0.894</td>
</tr>
<tr>
<td>SU2</td>
<td>0.900</td>
</tr>
<tr>
<td>SU3</td>
<td>0.806</td>
</tr>
<tr>
<td>SU4</td>
<td>Dropped</td>
</tr>
<tr>
<td>SU5</td>
<td>Dropped</td>
</tr>
</tbody>
</table>

Percentage of variance = 78.21, Internal consistency ($\omega$) = 0.839

### Customer Uncertainty (CU)

| CU1 | Our customers often order customized products to meet their specific needs | Dropped |
| CU2 | Our customers’ requirements regarding product or part preferences often change | Dropped |
| CU3 | Our customers often change their order over the month | 0.846 |
| CU4 | Our customers often change their delivery date over the month | 0.889 |

Percentage of variance = 62.93, Internal consistency ($\omega$) = 0.707

### Technology Uncertainty (TU)

| TU1 | Process technologies employed in our plant are complex | 0.709 |
| TU2 | Our plant uses core production technologies that often change | 0.658 |
| TU3 | Product technologies employed in our plant are complex | 0.718 |
| TU4 | Our plant uses core supporting technology that often change | 0.778 |
| TU5 | Our plant uses technology that has short technology life cycle | 0.751 |

Percentage of variance = 73.24, Internal consistency ($\omega$) = 0.727

### Competitor Uncertainty (COMU)

| COMU1 | Competitors offer lower prices that change over the year | 0.625 |
| COMU2 | Competitors’ actions regarding marketing promotions are unpredictable | 0.827 |
| COMU3 | Competitors often introduce new products features frequently | 0.787 |

Percentage of variance = 68.84, Internal consistency ($\omega$) = 0.730

KMO measure of sampling adequacy = 0.76, Bartlett’s test of sphericity (significant level) = 0.00
## Appendix A3

Constructs, Variables, Factor Analysis and Internal Consistency for Supply Chain Integration

<table>
<thead>
<tr>
<th>Product Quality</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>PQ1 We offer high performance products that meet customer needs</td>
<td>0.833</td>
</tr>
<tr>
<td>PQ2 We are able to produce consistent quality products with low defects</td>
<td>0.627</td>
</tr>
<tr>
<td>PQ3 We offer high reliable products that meet customer needs</td>
<td>0.807</td>
</tr>
<tr>
<td>PQ4 We offer high quality products that meet our customer needs</td>
<td>0.792</td>
</tr>
</tbody>
</table>

Percentage of variance = , Internal consistency (a) =

KMO measure of sampling adequacy = 0.92, Bartlett’s test of sphericity (significant level) = 0.00
글로벌 경쟁이 심화되어 공급사슬을 효과적으로 운영해야 할 필요성이 높아지고 있다. 단지 부품을 효율적으로 구매하고, 물류를 개선하는 것뿐만 아니라 품질을 높여 경쟁력을 향상시키기 위해서도 부품업체에서부터 소비자까지 이어지는 모든 프로세스가 통합적으로 관리되어야 한다. 자동차산업의 경우 완성차업체들이 공급사슬의 통합 필요성을 인식하고 있으나 경영환경의 불확실성으로 인해 실제 적용에는 어려움을 겪고 있다. 뿐만 아니라, 환경 불확실성(environmental uncertainty)이 가치사슬 통합과 품질 간의 관계에 미치는 영향에 대한 연구도 많지 않은 실정이다.

본 연구는 조절(moderator) 변수인 환경적 불확실성에 따라 태국 자동차산업의 가치사슬 통합이 제품 품질에 어떠한 영향을 주는지를 살펴보고 있다. 태국 자동차산업은 타 산업에 비해 공급자 불확실성이 높아 연구에 적합한 측면이다. 한편, 가치사슬 통합을 다루는데 있어, 가치사슬 통합을 분류하는 전략적 관점, 전술적 관점, 운영상의 관점 중 운영상의 관점으로 한정하였다. 또한 운영상의 관점 중 업체가 기본적으로 추진하는 기능적 통합은 배제하고 내·외부 통합으로 한정하였다. 내부 통합은 생산, 판매, 유통 등 기업 내부 기능의 통합을 의미하고, 외부 통합은 소비자 만족 극대화를 위한 소비자 통합과 비용절감 및 효율성을 높이기 위한 공급업체 통합을 의미한다. 독립 변수로서 가치사슬 통합은 내부 통합, 소비자 통합, 공급업체 통합 등 3가지 측면에서 분석하였다.

조절 변수로서 환경 불확실성은 고객 불확실성, 공급업체 불확실성, 경쟁자 불확실성, 기술 불확실성으로 구분하여 분석하였다. 고객 불확실성은 고객의 니즈 및 수요 변동을 의미하며, 공급업체 불확실성은 공급업체의 다이리, 품질, 운송의 변화를 의미한다. 경쟁자 불확실성은 경쟁자 행동의 예측 불가능성을 의미하고, 마지막으로 기술 불확실성은 제품 기술 및 프로세스 기술 개발의 변화와 관련된 것이다. 실증분석을 위해 공급사슬 관계에 정형한 생산, 구매 담당자들에게 5점 척도 설문지를 우편으로 송부해 자사 공급사슬 통합, 환경적 불확실성 및 품질을 평가하도록 하였다. 총 403개 중 111개 설문자가 회수되었다. 조절 변수의 정도에 따라 응답자들 두 그룹으로 나누어 독립변수와 종속변수와의 관계를 다중회귀분석과 쳔우 테스트(Chow test)로 분석하였다.

연구 결과, 기술 불확실성과 경쟁자 불확실성 변수가 유의미한 것으로 나타났다. 기술 불확실성이 낮은 경우에는 내부 통합과 고객 통합이 품질에 영향을 미치지 않으나, 기술 불확실성이 높은 경우에는 공급업체 통합이 품질에 영향을 주었다. 이를 해석하면, 신기술 개발 속도가 빨라지면 완성차업체들은 부서 간 프로세스 통합과 고객과의 통합을 꼭해야 한다는 것이다. 경쟁자 불확실성이 낮을 때 공급업체 통합이 제품 품질에 영향을 주고, 경쟁자 불확실성이 높을 때 내부 통합이 품질에 긍정적인 영향을 주었다. 이는 경쟁이 심화될 때 완성차업체들이 부품업체와 통합하지 않고, 분권화 혹은 내부 통합을 추진한다는 것을 의미한다.

본 연구는 완성차업체가 처해있는 경영환경에 따라 각기 다른 공급사슬 통합 전략을 취해야 함을 실증연구로 밝혔다는 점과 환경적 불확실성 요인, 공급사슬 통합, 제품 품질 간의 관계를 설명하는 연구모델을 개발하였다는 점에서 학문적·실무적 의미가 있다.
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