Analysis of International Expansion as a Tier 2 Supplier to the Auto Industry

by

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Submitted to the Sloan School of Management
and the
Department of Materials Science and Engineering
in Partial Fulfillment of the Requirements for the Degrees of

Master of Science in Management
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Master of Science in Materials Science and Engineering

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Abstract

This thesis, one part of a six and a half month internship at a major steel company, analyzes an international marketing opportunity in the steel business. The thesis looks at an international market from the Tier 2 perspective, where the Tier 2 does not currently have a presence in the new market. Data from the experiences at the internship site are used to develop a methodology for determining the feasibility and developing a European market strategy as a Tier 2.

The Tier 2 supplier currently has domestic business in this product, which is profitable and a differentiated product from typical products offered in the industry. The focus of the internship experience was the European auto industry. Thus, the case described in the thesis is described in this context.

The feasibility study and resulting recommendation consists of the following:

- A characterization of the current domestic market, including the steps involved in the value chain from Tier 2 to auto company. This includes an understanding of the technology involved in processing and manufacturing the product, and the applications which typically utilize the product.
- Organization of data collected from various companies that potentially comprise the steps of the value chain to the European auto company. The data is organized in a modified "Five Environments" marketing framework to be more suited for a market strategy from a Tier 2 perspective.
- Evaluation of various value chains constructed from data and knowledge of the European market, including distribution, Tier 1 selection, and target market. A spreadsheet model is used to determine the pricing strategies and net present value of different options proposed in the thesis. The spreadsheet model is used in conjunction with the Tier 2 market framework to make a final recommendation to the Tier 2 management.

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Professor Sandy D. Jap, Assistant Professor of Marketing
Professor Kenneth C. Russell, Professor of Materials Science and Engineering

Acknowledgments

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Our thanks particularly goes out to the people at the steel company where we did our internship. Mark B. Terry B., and Jack S. provided continuing support and advice throughout the learning process, data gathering, and analysis. The rest of the UHSS team also gets our warmest thanks for putting up with all our questions and bringing us quickly and enjoyably up the learning curve about steel processing, products, and applications. We also wish to thank Bob K. who provided crucial direction, feedback, and support as it was needed throughout the internship. We don't want to leave out Judy S. who played an important role in making the internship experience go smoothly and who was always their to help us.

Our thanks goes out to our academic advisors, Sandy Jap and Ken Russell who took an active interest in our project throughout the internship. They helped us gain perspective on our experience and see how our work relates in a broader context to other industry experiences.

The rest of the LFM class of '97 also deserves thanks for sharing experiences that helped us learn beyond what we saw on just our own internship. We would specifically like to thank those LFMs who spent their internship in Detroit and were able to give us further insight into the automotive industry. Rob Moeller and Jason Schulist deserve particular thanks for their advice and facilitation of interviews at Ford and Opel that accelerated our data collection process early on during the internship.

Finally our hat goes off to our lovely parents whose nurturing led us to be accepted into this prestigious academic program: Mr. James and Juiyun Hsu and Mr. Bernie and Gail Greenstein. Mr. Greenstein also deserves credit for having helped situate us 29 floors above Lake Michigan where it was easy to have perspective and reflection.

Table of Contents

List of Figures

List of Tables

1. INTRODUCTION

This thesis analyzes an international marketing opportunity in the steel business. The information is based on data collected during a dual internship by the two co-authors at Indiana Steel Company during the second half of 1996. The purpose of the internship was to determine the feasibility and recommend a strategy for selling ultra high strength steel to European automotive companies. This chapter provides some context for understanding this challenge and how the analysis will be conducted in subsequent chapters.

1.1 Indiana Steel and the Steel Industry[*]

80 million tons of flat roll steel are produced in the US each year. The producers consist of six large integrated producers and a number of smaller producers referred to as mini-mills. The integrated mills differ from the mini-mills in that they smelt iron from ore, limestone, coke, and coal. The mini-mills have to start with steel scrap which affects the level of purity that they can achieve. However, the mini-mills have an advantage in that they can achieve economies of scale at lower volumes and often at lower cost. In general, most steel is sold as a commodity product where price and delivery are the most important considerations. In addition to steel competitors, the steel companies are faced with a growing number of substitutes whose prices have in general been going down. As a result the industry profit margins are typically quite small.

Indiana Steel is the fifth largest of the integrated producers and has production capacity of 6 million tons of raw steel. In the past it has tried to position itself as a high end producer and does a sizable business with the automotive industry which represents 30% of the company's revenue. It has an active research group and has used this capability to produce products and assist in developing new processes for using these new steel products. Unfortunately, Indiana Steel is saddled with $750 million of debt from expansion activities in the late 80's. As a result, Indiana

[*] Note: Firm names, internal data, and financial numbers are disguised for confidentiality

Steel's net profit margins are running around 2%. This places their profitability towards the bottom compared to other companies in their industry.

However, one of the products that Indiana produces for the automotive market is UHSS (Ultra High Strength Steel). None of the other US producers can exactly match this line of products because of the unique capability of one of Indiana's production facilities. Indiana Steel built a Continuous Annealing Line (CAL) specifically for the production of high and ultra high strength steels. It currently runs approximately 20% UHSS which needs to be increased for the facility to achieve adequate return on its investment.

1.2 Market Opportunity

Indiana has set aggressive market targets for expanding UHSS in the US market. In addition, management wants to understand if opportunities exist to increase sales of UHSS by looking at other markets. For the purpose of this work, Europe was identified as the target market and bumper beams the market niche. Entry strategies for the European market are explored along the lines of technology options, potential partners, value chain construction, market penetration, and the financial evaluation.

The decision was made prior to the start of the internship to target the European market because of a general belief that the European market meets four needed characteristics. Firstly, the actual distance to Europe makes shipping steel expensive, but not prohibitively so. Secondly, steel prices in Europe are generally thought to be slightly higher then they are in the US. Thirdly, the presence of a large number of automotive companies in Europe provides both volume, and it is thought, the increased possibility that the value of UHSS will be accepted at least by some of the market players. Finally, Europe represents considerably more political and economic stability than many of the other possible market opportunities.

In 1995 Indiana Steel sold approximately 65,000 tons of UHSS to the North American market. Greater then 80% of this volume came from two automotive components: bumper beams and door beams. Indiana's penetration into the US market for these two products is approximately

30% and 20% respectively. The company projects their business to grow by greater than 50% by the year 2000. Indiana did not have any sales of UHSS outside of North America in 1995.

In the US, North American automotive manufacturing produces approximately 14M vehicles a year. Comparatively, European automotive manufacturing produces around 13.4 million vehicles per year. While targeting different components in Europe than in the United States might make sense, with limited understanding of the European market, it was assumed that the best approach was to target the same parts that had achieved success domestically. As a first order calculation, if similar market penetration could be achieved in Europe, this additional business could represent a doubling of UHSS sales. However, for reasons discussed in the next section, this first order approximation is highly optimistic.

1.3 Challenge

Indiana Steel is faced with the typical problems encountered by a firm wishing to enter a new market. Firstly, they must understand if the new market will have sufficient demand for their product. Secondly, they must understand how they need to position themselves within the existing value chain or how much new infrastructure they must develop. Thirdly, they must understand the total resource commitment required for successful implementation, and if this is realistic for the organization. Finally, the benefits must be weighed against the opportunity costs - financial, political , strategic.

Indiana faces some unique challenges with regards to the four areas outlined above. These deal with its constraints on timing and its position within the supply chain. It is generally believed by Indiana technical and business organizations that long term sale of UHSS in Europe is unlikely. The basis for this belief is that unlike the US steel companies, steel companies in Europe can produce similar products or have facilities capable of developing such products without significant capital investment. Further, a number of steel companies in Europe have strong financial positions and are very aggressively pursuing new product development. Given the added cost of shipment and duties associated with buying from Indiana and a preference for local suppliers, the opportunity for Indiana is believed to be a short term opportunity, perhaps lasting the next five years.

Adding to the timing problem is Indiana's position as a Tier 2 supplier. (The automotive industry uses the term Tier X supplier to identify the company's position within the value chain. A company selling a product directly to the automotive assembly plant is considered Tier 1. The Tier 1's direct suppliers would be Tier 2 and so on and so forth.) Indiana needs to generate market demand in the automotive industry for UHSS bumpers, but what it sells is steel. To be able to sell its steel it has two choices, or some combination of the two. It can attempt to generate enough interest at the auto companies so that the auto company will search out and help develop a Tier 1 player capable of forming the steel. It can also approach Tier 1 suppliers and convince them to develop expertise to push UHSS bumpers on their customers.

It is not believed that any Tier 1 suppliers in Europe have had experience with manufacturing UHSS bumpers. Many automotive factories and their suppliers are not even aware of the product. This means that Indiana must first educate the automotive companies before proving the economic value of UHSS. As a further obstacle, UHSS material would most likely need to be roll formed instead of stamped, the method used by steel bumper producers in Europe. This means Indiana must find bumper manufacturers willing to invest in a new technology or find a roll former who is willing to enter a new market they do not understand.

1.4 Structure of Analysis

While Indiana's international sales opportunity has a number of unique features, this sort of complexity is common in business today. As such, this thesis is intended to be an example of how to organize relevant market information, devise strategies, and evaluate their effectiveness.

Towards this end, Chapters 2 & 3 are intended to provide the necessary market information required for strategy formulation. Chapter 2 deals with the US market, the technology of producing and forming UHSS, and the US value chain structure. The targeted European market is discussed in Chapter 3. It is divided into nine sections based on a framework developed by Dickson[1].

[1] Dickson, *Marketing Management*

Analysis and conclusions are developed in Chapters 4 & 5. Chapter 4 is used to present the framework for evaluating the data on the European market. The specific analysis of the data follows and scenarios are generated showing different approaches to market penetration. Chapter 5 is used to present the final recommendations, assess the evaluation framework, and understand its applicability to other business decisions.

Two models were constructed and used in the analysis. The first model attempts to understand the competitive environment. It calculates a finished part price given raw material cost, part dimensions, and forming technology. This allows Indiana, as a raw material supplier, to better understand how it compares to competitors and can also serve as an educational tool for the automotive companies. The second model addresses the financial implication of pursuing the European market. It calculates Net Present Value for scenarios with different steel pricing structures, distribution systems, support costs, and volume penetration. While the results of these models are used in Chapters 4 & 5, the details are explained in Appendix A & B.

1.4.1 Marketing Research Framework

When a company contemplates entering a market, there are certain mental models that may be used to organize information in their decision making and marketing plans. One model proposed in Dickson's *Marketing Management* is the Five Environments (5E) Mental Model[2]. This model is used by firms to frame their market analysis. In general, a firm's knowledge of the marketplace consists of five environments: customer, competitor, own company, channel, and public policy orientation. A balanced, comprehensive view of the market involves full understanding of all of these forces. The five environments are described as follows.

1. Consumer Environment - segmentation of the consumer, analysis of key customer relationships, trends in values, needs, wants
2. Competitor Environment - market share analysis/industry analysis, competitive technologies and materials, trends

[2] ibid.

3. Own Company -understanding of the company's core competencies, strategy, financial goals, culture, capacity constraints
4. Channel Environment - technology changes and logistics, new channel trends, key distributor relationships
5. Public Policy Environment - regulations, political issues, public opinion, values, and ethics, assistance and support programs

A visual representation of Dickson's framework is shown in Figure 1.

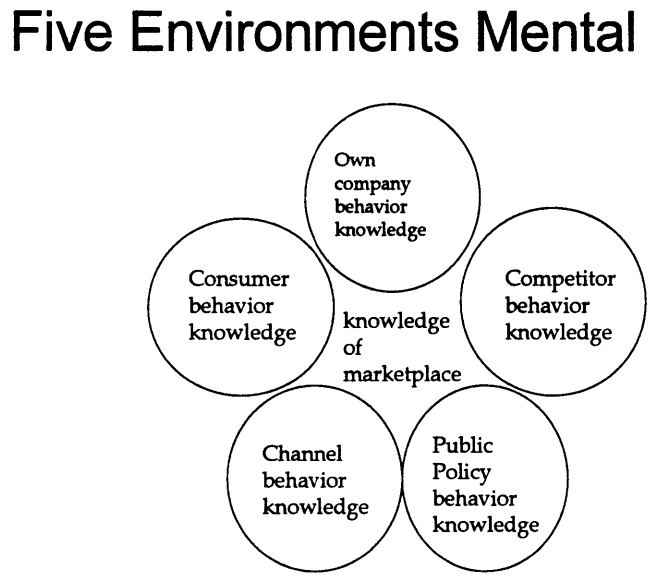

Figure 1 - Five Environments Mental Model

As mentioned before, these five environments are a general methodology for firms to follow. The model can be modified (adapted) to better suit the market faced by a Tier 2 supplier such as Indiana Steel. As a Tier 2 player that is driving the market, it is necessary to understand the world as seen by the Tier 1 supplier. In Figure 2, this adaptation is illustrated. In this diagram, there are nine environments, where the Consumer from the Tier 2 perspective is Own Company from the Tier 1 perspective. Tier 1 plays a dual role as Consumer and as Own Company. There are two rings formed around this entity, one which describes the environments between the Tier 2 and Tier 1 suppliers, and one which describes the environments between the Tier 1 supplier and final customer. The data collection for this study was focused along these 9 areas.

Tier 2 Environmental Model

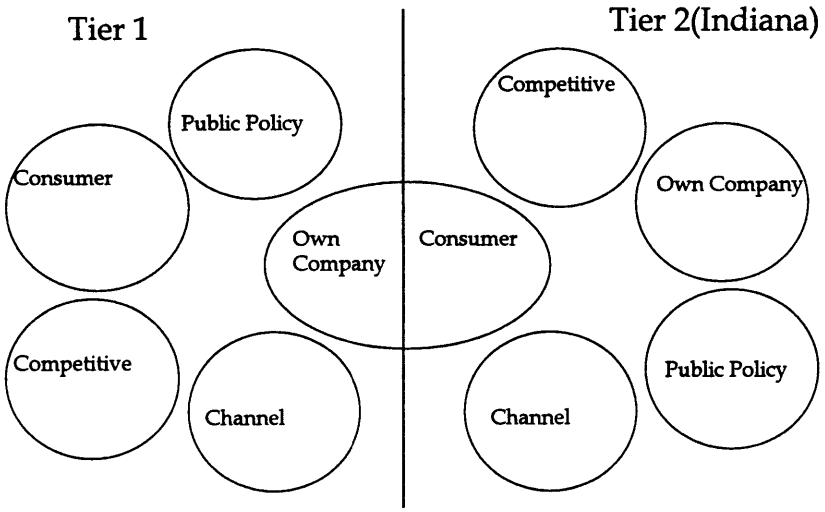

Figure 2 - Tier 2 Environmental Model - adapted from Dickson's Five Environments

1.4.2 Strategy Development Framework

There are many different ways to formulate a business strategy out of market information. As a Tier 2 player however, one of the key factors to consider is the integration of end user satisfaction with a viable value chain proposition. Ultimately, the financial numbers must be positive at all stages of the value chain and the Nine environments model information must be appreciated in determining the desired strategy.

To meet these needs, we have constructed a five step strategy development framework. The framework consists of the following steps:

1. Determine Attractive Markets
2. Value Chain Construction
3. Option Revision
4. Formulate market strategy, price, and required services for each option

5. Select best option based on financial assessment and fit to different environmental models

1. Determine Attractive Markets

As a result of building a customer environmental model during the market exploration, different market segments are identified. Now it is time to evaluate the attractiveness of each market segment. Four principle criteria are used for evaluation (first three taken from Kotler[3]):

1. segment size and growth
2. segment structural attractiveness (do you possess a competitive advantage?)
3. fit to company objectives and resources
4. fit to value chain partners' objectives and resources.

Based on the attractiveness of the market segments, certain markets are identified for further consideration.

2. Value Chain Construction

With a clear idea of which markets are attractive, value chains can be constructed to best serve those markets. The key evaluation criteria are the ability of the value chain to deliver the desired level of service and provide the product and service at low cost. This is balanced with the difficulties / risks of value chain construction.

3. Option Revision

Ideally, one would like to find that a single strategy would enable the company to serve all of the attractive markets profitably. However, as a Tier 2 supplier, your capabilities are strongly influenced by the rest of the value chain construction. The key activity at this stage is to see if any of the value chains designed above could be adopted to serve more than one market segment or if having multiple value chains is a feasible business proposition. This step provides a second look at the markets viewed as attractive in step 1 with a better understanding of the effects of the

[3] Kotler, *Marketing Management*

Tier 2 position. The output is a reasonable set of options that can be evaluated in further detail in steps 4 & 5.

4. Formulate market strategy, price, and required services for each option

At this stage, a marketing strategy must be purposed for each option. The marketing strategy then allows for pricing and required services to be approximated. This information will be required to do the financial assessment in step 5.

5. Select best option based on financial assessment and fit to different environmental models

In order to select the appropriate option for the company, the decision should be viewed with the broad prospective gained by looking at the environmental models. To formalize this process, each environment is reviewed to see that its impact has been factored into the quantitative financial and market analysis. Some environments will require a qualitative evaluation and need to be looked at in parallel with the quantitative data. By looking at both types of data, the most appropriate strategy can be determined.

2. BACKGROUND

2.1 UHSS Applications

The demand for UHSS comes from applications where the limiting design criteria is strength instead of stiffness. In these cases, objects can be designed using a thinner gauge (thickness of material) so that they are lighter but still have the same strength. This often is a cost savings as well since steel costs are calculated by weight. This is offset some by the premium added to specialty steels such as UHSS.

The product line that Indiana refers to as UHSS has tensile strengths ranging from 100 to 220 ksi (kilopounds per square inch) as compared to mild steels that might have yield strengths of 30-50 ksi. However, many applications use steel in structural support roles where it is important to limit the amount of bowing, a material property that is unchanged for UHSS. In these cases the UHSS is only a hindrance in that it is difficult to form into complex shapes because in its hardened condition it has limited elongation before breaking. For simple shapes, it still requires more force to form than the milder steels.

Indiana has found a niche market for UHSS in US safety components for automobiles. Indiana has had the greatest success in bumper beams (or reinforcement beams to what they sometimes are referred) where they have captured 30% of the US car market in terms of total vehicles sold. The Ford Taurus uses UHSS for both its front and rear bumper and at 550,000 vehicles a year represents over 7,000 tons a year usage alone. In the Taurus, the UHSS allows Ford to produce a very strong bumper while keeping the weight down by using a thinner gauge steel. The costs are also kept down as the bumper is made in a single step roll forming operation in high volume. (This will be further discussed in section 2.3.)

The need for a high strength bumper in the US is dictated by a combination of US law and Canadian law that collectively lead automotive manufacturers in North America to produce cars

that can take a 5 mph crash without damaging any of the safety components. To a lesser degree the Insurance Institute for Highway Safety (IIHS) that publishes the repair costs for cars under a series of crash tests also influences car companies to improve the strength of their bumpers. At this speed and for an average weight vehicle, if a conventional strength steel is used it will need to be around 2mm thick and require a robust designed cross-section (such as a closed shape, multi-hat design, or added reinforcement pieces) to effectively do the job. Figure 3 shows examples of some of these shapes that are used in bumper design. Since the goal for most manufacturers is to reduce the vehicle weight while keeping costs down, this 2mm thick steel bumper leaves significant room for improvement. One way to get the weight down is to switch to Al; however, this is expensive. Another option is to use the higher strength steel which on the Taurus allowed the steel gauge to be reduced to 1.1mm and ended up saving Ford weight and cost.

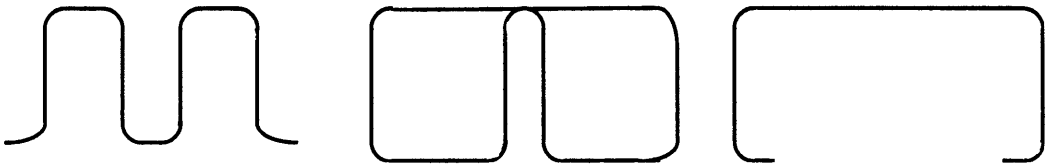

Figure 3 - Multi-hat, closed shape, open shape bumper designs

Under lower standards, the standard steel might not need to be so thick, and a simpler and cheaper cross-section requiring a single metal stamping might work just as well as two. This would make the cost hard to beat and leave little room for gauge reduction, because reduction in gauge can only reach a certain point before factors outside of tensile strength become relevant. With lower standards, a cheap plastic bumper might provide both the weight and cost savings the auto companies are looking for without any form of metal at all. This is why understanding the standards to which cars are built is one of the first steps when looking at any new markets for safety components.

A second niche market for the UHSS in the US is the side impact door beams. The Federal Motor Vehicle Administration has rules about the minimum amount of force it must take to bend a side door and to meet this standard most vehicles have reinforcement beams along each door. The competitors and product substitutes in this market are somewhat different, but again, the

ability to use a thinner gauge steel with higher strength has provided an appealing solution for many automobile companies.

Car seats are a third market that has grown in the US market. UHSS is used in seat tracks and other components of the car seat which require strong structural support.

2.2 Producing High Strength Steels, Indiana's CAL line

There are a number of ways to achieve high strength steels. However, Indiana is able to produce UHSS cold rolled coils with low alloy content. No other US steel producer can achieve the same strength range. What allows Indiana to gain this competitive advantage is their CAL (Continuous Annealing Line). See Figure 4 for a diagram of a continuous annealing line. The CAL can take steel with various low Carbon contents up to a high controlled temperature where the Carbon can be absorbed into solution. Then the CAL uses a very fast cooling rate (approx. 1000F/sec) which allows the Carbon to be locked into iron lattice without having a chance to diffuse out. Steel that has been taken to this high temperature (Austenite phase) and then quickly cooled so that the carbon is locked into lattice is referred to as a martensitic steel. Indiana can form martensitic steels of varying strength by modulating the carbon content between .08 and .25%. Indiana can also form dual phase steels of varying strength. To do this, they heat the steel to high temperatures (but not as high as for 100% martensite) so that only part of the steel converts to Austenite and upon rapid cooling only part of the steel converts to the martensitic phase.

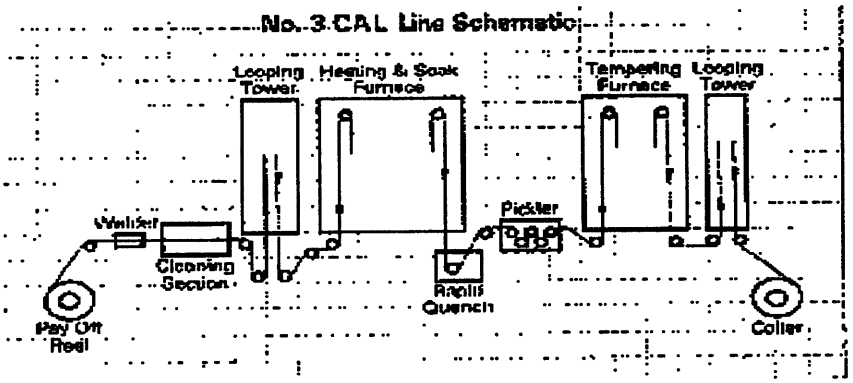

Figure 4 - Continuous Annealing Line

For the purpose of this paper we will limit our discussions of Indiana's UHSS products to Martensite and Dual Phase. The first is a fully martensitic steel with ultimate tensile strength of 220 ksi and 5% elongation. Dual Phase is a dual phase steel with ultimate tensile strength of 140 ksi and around 12% elongation. Further details on these two products can be found in Exhibit 1.

Table 1 - Martensite vs. Dual Phase material technical properties

	Martensite	**Dual Phase**
Tensile strength	220 ksi	140 ksi
Elongation	5%	12%

In the US, competitors produce steel coils with tensile strengths in the 120 ksi range and are trying to produce steels of even higher strengths. They do it by adding precipitates other than carbon that don't affect the strength of the steel during hot rolling, but can be made to precipitate out at around 1200F following hot rolling. This method of producing UHSS is difficult to control and results in less isotropic properties. The martensitic structure can also be achieved by doing a heating and quenching treatment after the parts are formed. This has the advantage of allowing the part to be formed while it has more elasticity and lower strength. The disadvantage to this method is that this adds an additional step and a cost which varies depending on the part size and shape. For instance, a tube shape can be more easily heated and quenched in a relatively cheap process. Tubes formed in this way are one of the main competitors for the door beam business where a tubular form is a typical shape. For the bumper beams this shape does not satisfy design requirements.

Outside of the US other companies have continuous annealing lines that can achieve the heating and cooling requirements similar to Indiana's CAL. There are also steel producers that have hot rolling equipment that can handle stronger steels then Indiana. The equipment enables them to make UHSS by increasing the level of Si in the steel.

The above descriptions are in no way a complete review of the methods of producing UHSS, but gives the reader a general grasp of Indiana's position with regards to production of UHSS.

2.3 Technology Options for Forming UHSS

Unfortunately, stronger steel has the disadvantage of less elongation before failure. This fact combined with the higher forming force required means that fewer forming options are feasible for UHSS than for mild steel. In this section there will be a brief description of stamping, roll forming, hydro-forming, tubular formation, welded blanks, and the Plannja process which constitute some of the most common methods used in the auto industry for forming steel. These methods will be evaluated in terms of their applicability to forming bumpers out of UHSS.

Stamping

By far the most common process used to form steel in the automotive industry is stamping. The stamping process can produce a wide range of shapes and sizes. Typically an expensive mold is created by careful machining and attaching a number of different metallic parts. The mold is referred to as a die. The die will be used in a press that will bring the die down hard on a sheet of metal placed beneath/between it. The shape of the die is therefore reproduced in the metal sheet. Often a series of stamping steps are required in succession to get the metal to the correct shape. Each step requires a separate die as additional folds are placed in the metal until it has the desired form. In the case of a bumper beam, the complexity of the shape will dictate how many steps are required. Because of the nature of the process, if the bumper is to have a closed profile like a tube instead of an open profile like a guard rail, then two parts would need to stamped. These two parts would then be welded together in a second operation.

A more complicated bumper with a closed section might require an investment on the order of $10 million for the stamping equipment and $3 million for the dies. Many automotive companies have their own stamping facilities which are used to provide parts for their assembly facilities. They typically still require some parts to be made by external Tier 1 component suppliers. While the dies are specific to a project, the stamping equipment is not dedicated. Die changes have become reasonably fast and multiple projects or parts can be produced by a single stamping press. Most bumper beam volumes are not sufficient to fill up a stamping line continuously.

The guidelines for stamping are partially based on the material being stamped. It is possible, though not necessarily easy, to design a stamping process that will work with some of Indiana's lower strength UHSS. This has been tried in the US. However, nobody is currently stamping UHSS in production. The highest tensile strength UHSS with very low elongation makes stamping virtually impossible with current technology.

Roll Forming

While stamping knocks the steel into the desired shape, roll forming more gradually bends the material. In roll forming the starting material is a steel coil instead of a blanked (cut) sheet of steel. The coil is unwound and passed through a series of rolls with progressively more shape. At the end of the roll forming line the bent steel is cut off into individual parts. This process has a number of advantageous features. It is done with a steel coil, and without any manual operations, shaped parts come out at the end of the roll forming line. In most cases there is still a worker stacking the finished parts, similar to what would occur at the end of the line in a stamping press. However, with roll forming, a closed part can be produced in a single operation. In the case of a closed bumper this is done by having the rolls fold the steel back on itself and using in-line welding equipment to secure the shape. See Figure 5 for a diagram of a typical roll forming line.

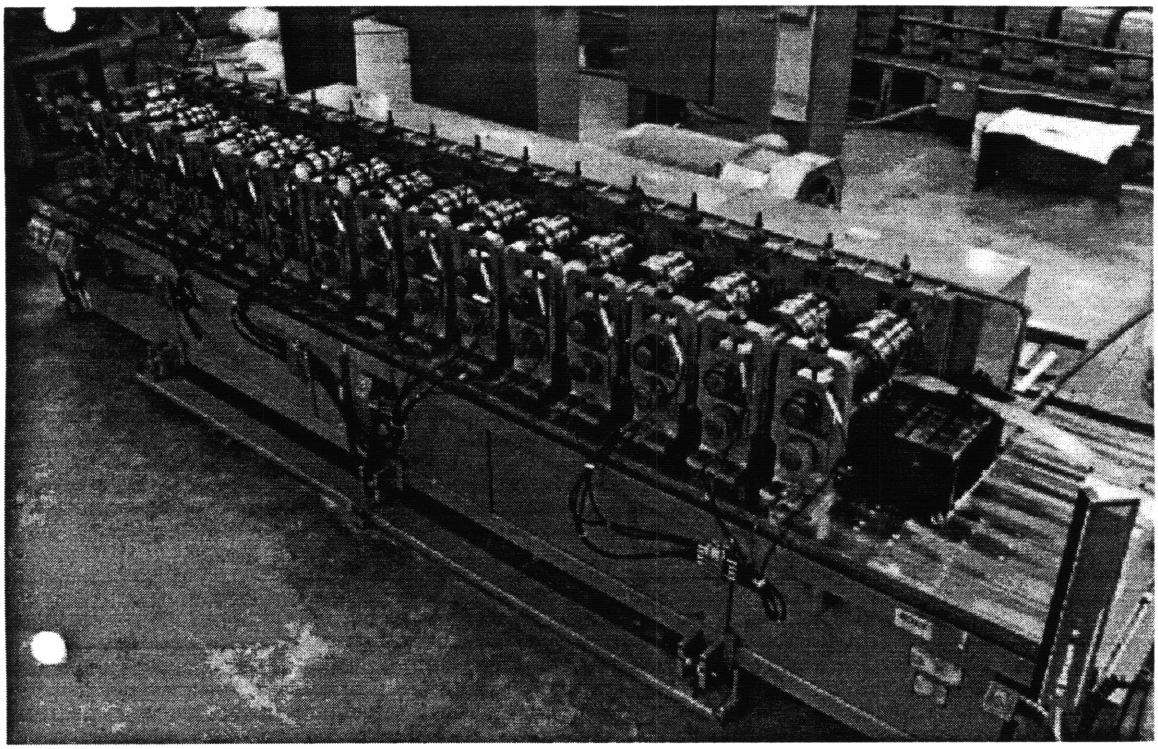

Figure 5 - Roll forming Line

A single roll forming line will typically run at 5-10 bumpers per minute. This is slightly faster or on par with a stamping line. The capital investment for roll forming is significantly less than for a stamping press. The cost is between $1M-$2M including investment in the tooling for the particular project and general purpose stands.

The problem, however, is that the shape of a roll formed part is limited. The cross section down the length of the part must be constant. Since the line is feeding off of a steel coil, the gauge must also be held constant. Further, without adding a separate operation, any curvature put in the part must also be constant. The nature of the process also ends up limiting the allowed total curvature of the part to a relatively low level.

All bumpers made out of UHSS are currently produced by roll forming. With only one exception, the roll forming is done by independent Tier 1 suppliers to the automotive companies. The UHSS has a higher level and variation in spring back when compared to mild steel. Because of this difference as well as the greater bending force and more limited elongation, there is a learning curve that most roll formers must go up when first starting to rollform UHSS.

Nevertheless, roll formed bumpers produced with Indiana Steel's UHSS have taken over 30% of the US bumper market.

Hydro Forming

As previously discussed, the stamping process can not produce closed sections without welding together multiple parts and the roll forming process is limited to shapes with a constant cross section. Hydro forming is a reasonably new technology that has neither of these limitations. There are a number of different forms of this technology. However, the most common starts with a metal tube and uses water pressure to expand the tube to fit a cavity. The advantage to this process is that there is part consolidation and often weight savings by not having to overlap the otherwise multiple parts that would require assembly.

However, this process has yet to be used for producing a bumper beam. While the economic assessment of using hydro forming to form a closed shape bumper beam is beyond the scope of this paper, even if this calculation proved favorable, it could not be used in conjunction with UHSS. Today's hydro forming process requires a minimum of 20% elongation for the simplest shapes and 35% for more typical applications. Indiana's closest product to meeting the requirement, Dual Phase Steel, is still unable to be hydroformed because its elongation is 12%.

Tubular Formation

Steel tubes can be produced in a variety of methods. One of the most efficient methods is a basic method of roll forming. Instead of making intricate shapes, circular tubes are produced. Dedicated roll forming lines make standard size tubes of varying diameters and material strengths. These tubes are very popular in doorbeam applications, and are beginning to gain exposure in other applications.

Welded Blanks

One of the technologies that is getting increased attention in the automotive industry is tailor welded blanks. The idea is to attach (weld) different sheets of metal together to form a larger

sheet which then can be composed of varying strengths and / or gauges. The sheet would then be stamped in the same way a homogeneous sheet of steel would be stamped. The advantage to this process is that customers can get extra strength or thickness in the exact areas that they need it, which could save material and weight. This savings has to be offset with the cost of welding the sheets together. This is also a relatively new process and there are a variety of types of equipment which work in different ways. Some of the systems use laser technology, others induction welding, and others use a mash welding process.

Bumper manufacturing has yet to utilize this new technology. In the case of UHSS, the welding process might be a little more complicated, but is not technically insurmountable. The problem again rests on the limitations of stamping the UHSS welded blank. To this date, no Tier 1 or 2 has welded together complete steel coils, which would be required if this technology were to be combined with the roll forming process.

Plannja Process

A company in Sweden has come up with a new process for forming steel which they call the Plannja process. In this process, steel sheets are placed into a furnace where they are heated to 900 C degrees. The hot sheets are then placed into a stamping press which has a specially built water circulation system and water cooling dies. The die comes down on the material, but instead of coming back up immediately, it remains in the clamped down position for about 30 seconds while the water cooled dies quench the steel sheets to 90 C degrees. This process has two primary advantages. First, it allows the steel to be stamped while in a hot state where the power required to stamp it is lesser, and its malleability (elongation) are high. Second, the furnace heating and subsequent rapid cooling in the die can produce a martensitic steel of strengths ranging as high as Indiana's top of the line UHSS.

This process is a significant threat to Indiana's UHSS product line. It can produce parts with similar strength levels. It is also not limited to shapes that can only be roll formed. Ford has licensed this technology from a European steel company, EURO Steel, that has patented the Plannja process. They also import a few Plannja processed parts for high end, low volume vehicles. A Plannja processing facility is also planned to be built in the US in 1997.

The Plannja process uses a boron steel as its starting material. This steel is produced by any number of steel companies. The less expensive base material represents a threat to Indiana's UHSS product line, which is typically sold at a premium. However, the capital costs associated with the Plannja process are significantly more than that of roll forming. It remains to be seen at what range of prices Plannja parts will be offered after the new US facility is built.

2.4 North American Value Chain for Bumper Systems

There are a number of different ways to envision the value chain. For the purpose of this paper we start with the steel company and terminate with a bumper system sold as part of an automobile to the end consumer. In this thesis we discuss the prospect of the US Tier 2 supplier who is attempting to supply steel to a European auto company. Much of this hypothetical supply chain will be similar to the North American value chain which is currently in place today. This value chain is shown in Figure 6.

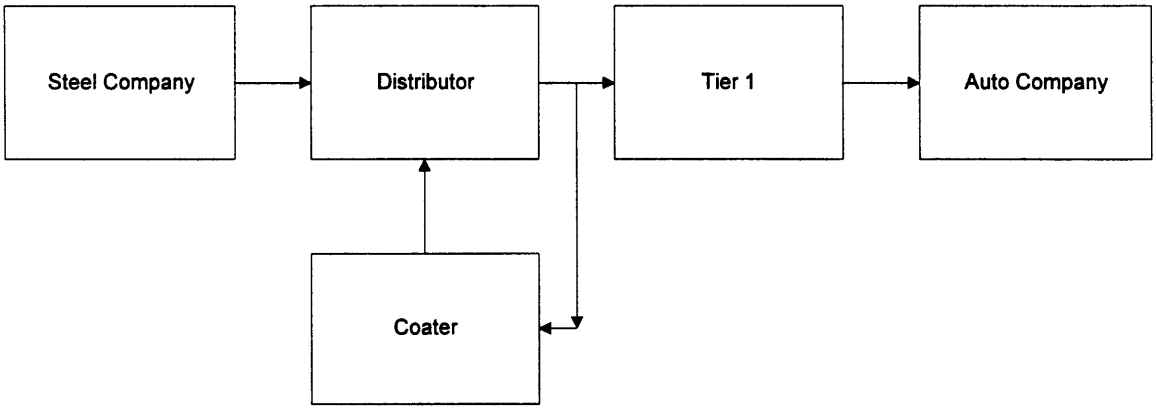

Figure 6 - North American Value Chain

2.4.1 Steel Company (Tier 2 Supplier)

As was mentioned in Section 1.2, Indiana Steel is a Tier 2 supplier to the US UHSS bumper market. A steel company is the raw material supplier. In the US, Indiana Steel has the most extensive range of UHSS products. Responsibilities that are assumed by the Steel Company in the domestic market can include some of the following.

- Technical service and support for immediate user (Tier 1) of the steel
- Technical service and support for the end user of the steel (auto company)
- Work on design with Tier 1 and auto company designers in determining steel specifications for new bumper designs
- Early involvement with key auto company decision makers to educate on material choice prior to design phase
- Development of simple modifications to steel composition and/or processing to better fit the customer manufacturing and design needs
- Ensure adequate capacity to meet demand for the raw material. The steel company is responsible for ensuring that orders are manufactured
- Ensure adequate delivery schedule for raw material to the next step of the value chain.
- Quality aspects of the raw material (within the scope of control of the steel company are important to control)

We have mentioned that in the US, 30% of the bumper market is UHSS. There are other steel companies, however, that supply material to the bumper market. These steels are of lower tensile strength than Indiana's UHSS. The closest steel grade competitor to the Indiana UHSS line of products is a product called RA-120, which matches the tensile strength of the low end of the Indiana UHSS line. This product is offered by several US based steel companies. Differences between UHSS and RA-120 can be best summarized by Table 1.

Table 2 - Comparison between UHSS and RA-120

UHSS	RA-120
isotropic steel	anisotropic
tensile range 100-220 ksi	tensile limit 120 ksi
dual phase can be stamped or roll formed limited stamping for fully martensitic steel (mainly roll formed)	can be stamped or roll formed

In general, when manufacturing a bumper reinforcement beam from a high tensile strength steel, about 2/3 of the costs are in the material. The ratio will vary somewhat with pricing and tensile strength. If the tensile strength increases and this allows the thickness of material to be reduced, the ratio will be less.

2.4.2 Coater

In the US, there are guidelines which govern how long a bumper should last out in the field. Out in the field means in the consumer's possession and use. Currently, the automotive norm is 10 years or 150,000 miles. Each auto company has an internal corrosion standard, which makes it difficult define a specific corrosion standard that applies to all companies and models.

There are several methods by which corrosion protection is provided on a bumper reinforcement beam. In the automotive industry the method of choice is coating and linings which can either be metallic, inorganic, or organic. These coatings can be applied two ways: 1) coating on raw steel coil prior to forming, and 2) coating on the part post forming. In the US, there is a range of coating requirements for each of the Big Three Automotive Companies. All require an aftercoating, often referred to as e-coating (described later in this section). Some require a coating on the steel sheet as well. Ford Motor Company appears to have the most stringent requirement of the US auto companies, but, again, this varies within the company depending on which platform is being considered. Table 2 shows the breakdown of current US market requirements for bumper corrosion protection.

Table 3 - US Market Corrosion Requirements for UHSS Bumpers

Company	Coating Requirements
Ford	would like to have 150k mile protection by next year; there is concern that Zn coating might not work towards this goal; other types of coatings are under investigation
Chrysler	currently require 100% galvanized steel, but are now looking at bolting on and then e-coating with the rest of the body
General Motors	e-coating
Honda	e-coating
Toyota	e-coating

In this section we will discuss the different options for corrosion protection that an auto company may choose for their bumper system.

There are two types of coatings for corrosion protection, sacrificial and barrier (noble) protection. These classifications are determined by the degree of galvanic action which takes place at the base of an imperfection in the coating. Galvanic corrosion occurs when two or more dissimilar metals are in contact or when same metals have an electrolyte present, which produces an electrolytic cell. Depending on the position of the metals on the galvanic series, one will act as an anode and the other will act as the cathode. The anodic side will corrode, while the cathode will remain protected. Whether or not a coating is sacrificial or noble depends on the choice of coating material on the galvanic series with respect to the base metal[4]. The galvanic series of metals and alloys is listed under Appendix C.

Sacrificial Protection

Sacrificial coatings consist of coating material where the base metal is noble in comparison to it. Examples of metals that are sacrificial are zinc, cadmium, aluminum, and tin. These coatings result in a cathodic protection of the base metal and attack on the coating metal, as long as there

[4] *What Every Engineer Should Know About Corrosion*

is sufficient current flow and electrical contact in the coating. Figure 7[5] shows the effect of galvanic action with a sacrificial coating.

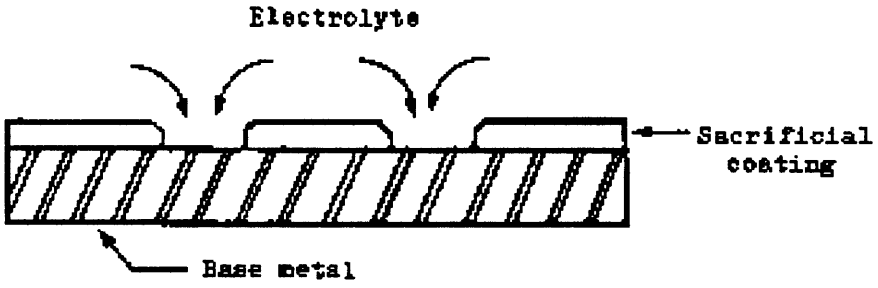

Figure 7 - The Effect of Galvanic Action with a Sacrificial Coating

In the steel industry the thickness of coating is desired to be as thin as possible. Moreover, uniform thickness of the coating is desired by customers for ensured quality of steel. Therefore, tight tolerances are necessary to apply this type of protection to steel. It is typically applied to a steel coil rather than on a post formed part. We will talk about the two most popular methods of providing a sacrificial coating to UHSS: electrogalvanizing and hot-dipped galvanizing.

Electrogalvanizing - In this procedure, as the steel coil is produced it goes through tandem roll, annealing, and temper roll before it is electrogalvanized. The steel is made the cathode in a series of electrolytic cells through which the coil passes (see Figure 8 for drawing of electrolytic cell). The electrolyte contains the coating metal in ionic form. As the coil passes through the electrolytic solution, Zn ions are bonded to the microstructure of the surface. The typical thickness range of coating is between .60 and .90 ounces of coating per square foot on each side of the steel. The electrogalvanizing process is done without heat. Thus, the strength of the steel coil is retained. A drawback to the process is the higher cost compared to other galvanizing methods.

[5] *What Every Engineer Should Know About Corrosion*, p. 73.

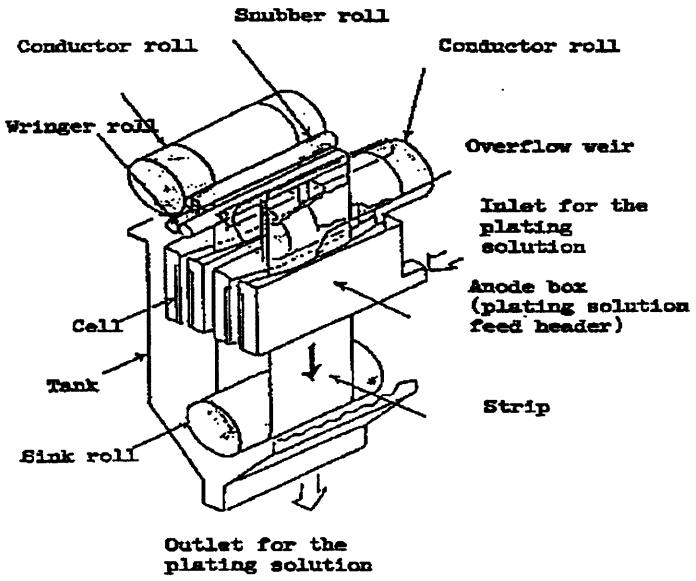

Figure 8 - Electrolytic Cell

Hot Dipped Galvanized - In this process, 2 unit operations are combined - the coating and heat treat process are one event. The steel coil passes through tandem roll, anneal/coating, then temper roll. The zinc metal is molten and the steel coil passes through the bath in the coating process. The metal coating is 20% intermetallic, meaning there is an alloy layer that forms between the zinc and the steel. This intermetallic layer is very brittle. A major drawback to the hot dipped galvanized process for ultra high strength steels is that because of the high temperature of the molten zinc metal, the substrate is essentially annealed, decreasing its strength by approximately 20-30 ksi from what it would have been if it were electrogalvanized or not coated at all.

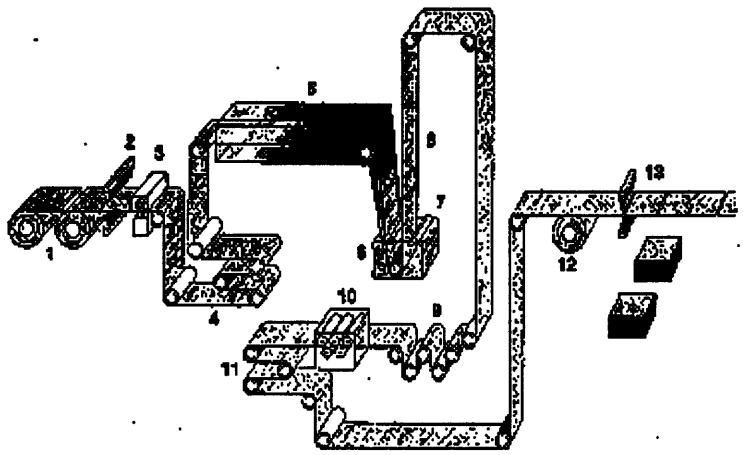

Figure 9 - Hot Dipped Galvanizing Line[6]

Barrier Protection

The other type of protection that is used in the auto industry is called barrier coating or noble coating. The most typical method barrier coatings are applied through dipping or spraying. This means that parts as well as coils can be treated by this method. Barrier coatings are noble in the galvanic series with respect to steel. This can result in corrosion at the imperfections in the coating, caused by galvanic current attack. To reduce the extent of the attack, thicker coatings must be applied and/or minimal pore size between coating and base metal must be maintained. In the automotive industry, barrier coatings are generally thought to be lesser protection than sacrificial coatings. This is because the base metal is more vulnerable to attack when imperfections or scratches appear on the metal parts. Figure 10 shows the interaction of galvanic current with a noble coating.

[6] *Corrosion Technology for Scientists and Engineers*, p.105

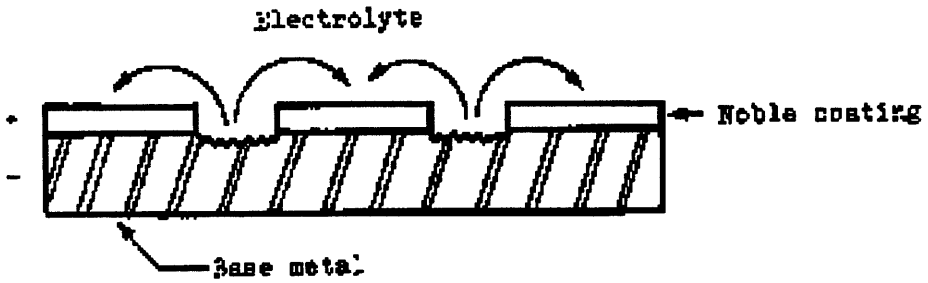

Figure 10 - Galvanic Action with Noble Coating[7]

We will discuss three barrier protection methods that have been used in North American applications.

E-Coating - In this process, commonly used in the auto industry, coating chemical is electrolytically deposited. The work piece is treated as a cathode and paint pigment particles are attracted to this work piece as it is dipped in a current induced bath. Depending on the complexity of the shape, the outside surfaces of the part are easier to coat than the inside surface. Common disadvantages to this process are that uneven coatings may occur (see Figure 11). Because of this, it is sometimes used as a pre coating to further coating or painting, rather than a corrosion protection stand alone method.

[7] *What Every Engineer Should Know About Corrosion*, p. 73

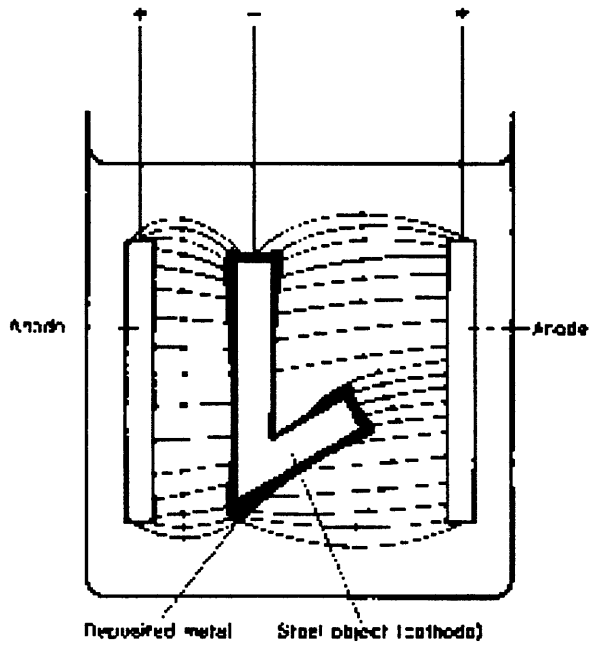

Figure 11 - Uneven Current Distribution in E-Coating[8]

Dacromet ™- This compound is a trade name for a water based corrosion resistant coating for steel which contains

- metal oxide in solution
- metal zinc and aluminum flakes
- proprietary organics

The cleaned part is dipped into a liquid coating bath and cured. It can also be sprayed on the part by air, airless, or electrostatic equipment. The coating becomes totally inorganic after the curing stage at 619 F. This coating method has found increasing acceptance in one of the Big Three auto companies, but has still to find industry wide acceptance as a superior corrosion protection over traditional zinc coatings. Dacromet™ has a similar disadvantage to other heat based coating methods in that it too results in a reduction in steel strength from the heat of the process.[9]

[8] *Corrosion Technology for Scientists and Engineers*, p.103.
[9] Data from Metal Coatings International

Properties of Dacromet™

- 5-7 microns thickness (relatively thin)
- metallic silver-gray appearance
- corrosion protection >240-1000 hours salt spray
- bimetallic corrosion resistance
- resistance to all organic solvents
- electrically conductive

Phosphate Coatings - Phosphate coatings provide less corrosion protection than the other methods that have been described. The advantage to this coating is that the phosphates act as a good adhesive to which paints or other anti rust preventatives can stick better. Phosphating depends on chemical reactions to achieve deposition. The basic premise is that the metal reacts with the treatment agent so that a thin, difficultly-soluble coating is formed on the metal surface[10]. This coating is highly porous and can absorb oil. In combination with other anti rust preventatives, rust is prevented from spreading into the pores of the coating. While phosphate coatings are usually used in combination with other measures, there are some industry initiatives driving for the use of this method as a separate coating method by itself. Some people in the industry consider this method comparable to e-coating, which also is sometimes used as a primer for further painting steps.

2.4.3 Distributor

The distributor (or service center) is responsible for the shipment of steel coils to the customer. This means they may be responsible for a total inventory management system where material planning and forecasting ensure JIT deliveries to the customer. Orders are tracked through computer technology and bar coded shipping tags.

More often, a customer will choose to have shipments facilitated by a full service distributor, or service center. These are distributors that also provide services such as slitting, cutting to length, and blanking of steel coils.

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[10] *Corrosion Technology for Scientists and Engineers*, p. 108

Slitting - This is the process whereby a master coil of steel is cut through such that the width of the coil is to a desired specification. For ultra high strength steels, there are special knives that should be used to process high tensile strength steels.

Cut to length - During the steel making process, the length of the master coil can vary depending on the amount of slab material originally run through the system. At the service center the master coil is run through a machine that cuts to the desired length ordered by the customer.

Blanking - This processing is typically done for stamping operations. A blanking machine cuts the coil into shapes of a desired dimension. The blanks are then stacked and packaged for ready shipment to the auto company.

There are many service center/distributors in the United States. In some cases these distributors are part of a larger company that actually manufactures steel. This is the case with the manufacturer of ultra high strength steel in the US. A portion of Indiana Steel's ultra high strength steel that is sold domestically goes through Indiana Steel's distribution subsidiary, Frank's Warehouse* . This organization has also the capability to distribute materials from non-Indiana sources, including aluminum and plastics. They have their own management, sales force, purchasing department, quality assurance, and operating teams with which they are equipped to serve customers who require a variety of different materials. Although they have an affiliation with Indiana Steel, Frank's Warehouse is not Indiana Steel's required distributor. They must meet competitive prices in order to gain business.

Distribution accounts for approximately 5% of the total cost of a bumper reinforcement beam.

2.4.4 Tier 1 Supplier

The Tier 1 supplier in North America is the entity that manufactures parts to the auto company specifications and delivers the parts to the auto company in a just in time fashion. In some cases more activities are assumed by the Tier 1, such as design and testing work. There are several roll

* name disguised to protect company confidentiality

formers in the US that have worked with ultra high strength steels. As was mentioned in previous sections Indiana's UHSS makes up 30% of the North American bumper market. This is a significant portion of the market. Thus it is not surprising to have several players in this business.

A description of the main Tier 1 suppliers in the US is listed blow.

Supplier US-A

This company is a major supplier to one of the Big Three Automotive Companies.

Supplier US-B

This company is part of a larger company, which does have an international presence. The parent company owns many subsidiaries which do various operations with steel. Examples include hydro forming, roll forming, and tube making. US-B supplies most of the North American automotive producers. This company has aspirations to grow as a high quality supplier to the automotive industry.

Supplier US-C

This is a company that does roll forming for three North American producers. They are a growing company. Good technical service and design capability. They also use a large amount of RA120.

Supplier US-D

This Tier 1 supplier is owned by one of the Big Three Automotive Companies. It consists of 3 roll forming lines that are rafted to provide quick tool changes so that different products can be run on the same line. Currently they are using the line for replacement parts. Trade publications indicate that the company has been evaluating if it makes sense for them to continue this activity in-house. The advantage of this arrangement for the auto company is that all the expertise with regards to design and manufacturability lies within the company.

Table 4 indicates the market share each of these Tier 1s have of the bumper market in North America.

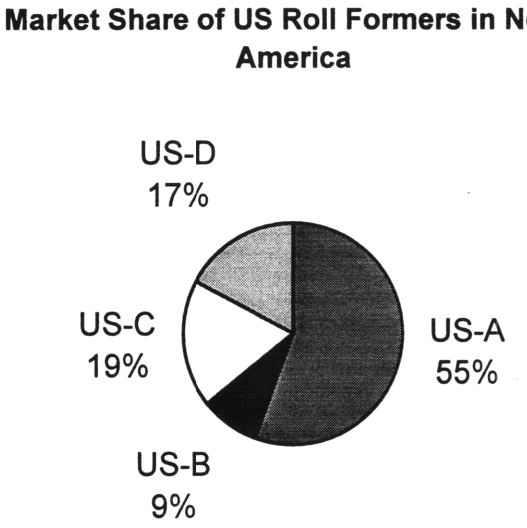


Table 4 - Bumper Market Share of US Roll Formers in North America[11]

2.4.5 Auto Company

The driver behind the entire North American value chain is the auto company, for obvious reasons. Currently there are 5 companies that purchase ultra high strength steel for bumper applications in the US and North America. We describe them briefly here.

Ford

Ford is the second largest auto company in the world. They are a major customer of Indiana Steel, and are a good prospect with whom to continue relations in the future. Ford has a new global strategy, termed "Ford 2000" which calls for commonization across car platforms. This means that the total number of Ford platforms will decrease and more models will use fewer platforms. There do appear to be synergies among Ford locations globally. Designs for local cars are not necessarily made in the local country.

[11] Marketing Study, Indiana Steel Company, Numbers have been disguised to protect confidentiality of the companies involved.

GM

General Motors is the largest auto company in the world. They are more decentralized than Ford is, with respect to car platforms and control of designs. GM has typically used the dual phase steel in their North American applications. GM purchasing has traditionally held an iron fist over its suppliers, forcing cost reductions each year or threatening loss of their business. They do not like to single source. Hence, they also purchase RA120 in addition to UHSS for other bumper applications.

Chrysler

Chrysler is the smallest of the Big Three. They do not have any significant international operations outside of North America. Rather than focus on cost, they are more responsive to weight and design benefits for raw materials. Chrysler tends to choose a Tier 1 supplier early in the program, and has that supplier takes responsibility over raw material choice. Design is very closely controlled internally.

Toyota

Toyota has begun to use some UHSS for North American produced vehicles.

Honda

Honda is a company that is strongly influenced by their headquarters in Japan. The key decision makers regarding material selection are the bumper designer (Honda engineer) and purchasing department. Honda will be launching its first vehicle with UHSS in the end of 1997. There is an indication that Honda strives for commonization of efforts across similar markets, i.e. North America and Europe.

2.4.6 North American Trends

If we were to characterize the trends occurring in North America regarding bumper reinforcement beams, one of the largest is the 5 mph bumper standard, which companies are trying to meet at lower cost and weight.

In the past the market for ultra high strength steel in the US bumper market has consisted of UHSS and RA120, and one Plannja beam for a low volume model car. However, with the planned opening of a Plannja processing facility in the US, Plannja may be a larger threat.

Based on marketing studies, the market for ultra high strength steel in North America is expected to grow, although increased competition is likely to enter.

3. Market Research Findings

For the purpose of this paper, data is focused on the application of UHSS for automotive bumpers. The information is arranged into nine environmental reports, following the framework described in Section 1.4.1. Each section begins with bullets. The objective is for a few simple bullets to paint a picture of the environment. A more detailed discussion follows to build the case for the bulletized summary. A tenth section is added to discuss the overall confidence in the research findings and to suggest where additional information should be obtained.

The data in this section was collected during the co-authors' six and one half month internship and roughly consisted of the following activities:

- Business discussions with Indiana employees in manufacturing, research, marketing, sales, and the international group.
- Technical discussions with R&D regarding products, product usage, and current knowledge of competitors
- Interviews with N.A. customers (automotive companies & Tier 1 suppliers)
- Internet searches and cold calling of automotive companies, suppliers, and distributors
- Interviews with European customers (automotive companies & Tier 1 suppliers)

3.1 Public Policy Environment (Tier 1)

- Many more bumper solutions are available in Europe because of lower government safety regulations
- Typical European bumpers have less packaging space and more curvature because of desire for shorter cars and differing tastes
- Differences in insurance testing and high speed vehicle crash testing between the US and Europe make global bumper design difficult

3.1.1 Government Regulations

Three types of regulations have a direct or indirect effect on bumper design in both Europe and the US. There are bumper standards that specify a level of damage to safety components in a low speed crash. High speed crash tests are also performed to evaluate the car in terms of passenger safety where the bumper may play a role. Finally, different forms of government incentives are used to encourage lighter vehicles. The bumper, like a number of other components, is a target for weight reduction.

3.1.1.1 Bumper Standards

Automotive companies prefer to produce one vehicle for both Canada and the US. As a result the bumper standard ends up as a composite of the two government regulations. This standard includes a 5 mph crash test for passenger vehicles where no damage is allowed to safety components. Regulations on sport utility vehicles and trucks are not as stringent.

In Europe, the Economic Council for Europe (ECE) has a bumper standard. However, this is only a recommendation and only two countries (both Eastern block) have incorporated these standards into law. The standards are also much looser than in the US. Tests are conducted at half of the speed (2.5mph) and allow significantly greater damage to the vehicle.

3.1.1.2 High Speed Crash Testing

Concern with passenger safety from head on collisions is addressed by government regulations specifying automobile performance in high speed crash testing. In the US auto companies must meet a 30 mph frontal crash test into a rigid barrier. The bumper's role in a high speed crash is to absorb some of the initial blow (typically 1-5% of the energy) and to help (or at least not hurt) the way the remainder of the energy is absorbed by the car's structure. The impact of bumper design on high speed crash testing is not fully understood and varies some by vehicle, resulting in different car companies' strategies.

In Europe, the vehicle undergoes a 35 mph frontal crash into a semi-rigid barrier that is 40% offset to the driver's side. This test will be a requirement for all new model cars sold in Europe

by 1998. The differences between US and European standards introduce the possibility for different design considerations particularly in the way the bumper is attached to the rest of the vehicle.

3.1.1.3 Regulations Pushing Weight Reductions

In the US, the Corporate Average Fuel Economy program (CAFE) sets standards for the average fuel economy of a company's cars sold in the US. Reductions in vehicle weight is one of the big drivers for improving this performance. The bumper is one of the components often targeted for weight reduction. In general up to $2 per lb. is given as an indication of the value of weight reduction in the US market. However, this is a not an easy value to estimate because it varies by car and even by the auto company's progress in the development cycle (are they in trouble of not meeting the performance they promised?).

In Europe, emission requirements increase with weight class. As a result, if the car goes into a higher weight category, higher engine costs result and may force a manufacturer to do last minute design changes. This gives European producers an incentive, similar to the US producers, for weight reduction. Again, it can vary significantly between vehicles. While not a government regulation, high performance cars in Europe are also concerned with performance differences in weight balance. As a result, different value may be placed on weight reduction from the front to back of the vehicle. Typical numbers quoted for Europe were up to $7 / kg.

3.1.1.4 Likely Changes to Regulations

There is not much momentum for changes to European bumper standards. Typically, recommendations that become part of the ECE are followed up a couple of years later by being made law as part of the EC. However, this ECE recommendation has been around for over a decade with not much pressure to propose legislation in the EC.

The Pedestrian Safety Act is a requirement that has been proposed in the European community. It also influences the design of safety components. However, the safety of pedestrians rather than car occupants is the chief concern. It has been in the proposal stage for many years. It is

unclear whether or not is very significant in the design of safety components. It basically calls for limited protrusions, etc. that might strike a pedestrian on impact. The range of concern over implementation varies from company to company, but in general the feeling is that the proposal will not become a requirement in the near future.

3.1.2 Insurance Testing

Similar to regulatory requirements, there are also insurance agency tests which auto companies consider in component design and material selection. These organizations perform their tests and publish results with respect to repair / replacement costs in addition to safety concerns. In the US, the Insurance Institute of Highway Safety (IIHS) is the organization with the most visibility. They perform a series of four tests at 5mph. The statistics are published in a newsletter for consumers to read.

Insurance testing in Europe is conducted at 9mph at a 40% offset. The results are used to classify cars into different insurance ratings. The cars' performance on the insurance test can have a significant impact on the cost of insurance, particularly for the vehicles in the lower end bracket. In high end cars, especially performance cars, the insurance rating is relatively less important in determining insurance cost. The higher speed used in the European testing means more damage is allowed to the end of the car and tends to place more of an emphasis on replacement cost for components than on repair as compared to the US's requirements.

3.1.3 Coating Requirements

The automotive industry in the US seems to have an unwritten standard that a coating needs to be on steel safety components to help combat corrosion. Lax as it is in the US, it appears even less of an issue in Europe. In interviews conducted with the European auto companies, corrosion concerns are not very evident, even at the American transplants (Ford, Opel). There are no corrosion requirements mandated by law in Europe.

The European auto companies do follow coating procedures, but the main form of coating used is the e-coating form of barrier protection rather than sacrificial coatings, which are used more frequently on North American operations.

3.2 Consumer Environment (Tier 1)

- While the European bumper market is very large (similar in size to the US), only a little more than 20% of the market is available to Indiana for sales of UHSS. Design limitations imposed by having to roll form UHSS is the biggest detractor.
- In general auto companies just follow the safety mandates passed by the European Union. Because these mandates are lower or non-existent compared to US standards, auto companies also are more lenient in their standards (a good example of this is the lack of corrosion standard)
- The requirement for local presence and varying levels of service allow the market to be broken into six market segments.

This section will look at the European market for bumpers and attempt to understand what segments of the market are feasible for Indiana Steel, the size of each segment, and what sort of customer requirements will be demanded. To provide a systematic method for doing this evaluation we progress from total market to potential market to available market. We then discuss the different customer demands from the available market which then allows us to divide the available market into market segments. Our definitions for each of these terms are explained at the beginning of each section.

3.2.1 Total Market

The *total market* includes any customer which could have interest in a European automotive bumper, the product classification we are trying to fill. As such, the relevant consumers are all European automotive manufacturers which have a combined output of 13.4M vehicles / year. As a first approximation, with a weight of 6kg / bumper, considering both front and back bumpers the Total Market represents an annual need for 161K metric tons.

3.2.2 Potential Market

The *potential market* includes any customer whose needs could potentially be met by using a UHSS bumper as their bumper solution. Unfortunately, an UHSS bumper has limitations which prevent it from becoming the sole solution for front and back bumpers throughout Europe. In fact, the potential market is significantly smaller than the total market. Four primary limitations shrink the size of the total market: design limitations, cost inelastic high end cars, low volume vehicles, and cost elastic low end cars.

As talked about in section 2.3, forming UHSS poses a number of limitations because of its low elongation. If roll forming is used, the bumper's design is limited to a constant cross-section and limited / constant sweep (curvature). More than half of the current cars produced in Europe have a shape which can not accommodate these design limitations. Styling is unlikely to be changed to accommodate a new bumper material. However, in some cases, with sufficient early involvement, an UHSS bumper can be worked into the design. Early involvement is a process where by the automotive company involves the supplier in the design process prior to the material specification. This is something that Indiana Steel does a lot of in the United States and has played an important part in proliferating the use of UHSS.

For some high end cars, the cost of the bumper will be passed onto the customer and performance and weight are more important. Al is typically used in these cases. For many of these automobiles the decision to invest in a re-design away from Al does not make sense and is not likely to happen.

Another sector that would be very difficult to win over is low volume vehicles. For these vehicles it is very important to keep capital costs down. This makes plastics or extruded Al more economical than stamping or roll forming. Even though a separate stamping press would probably not be required for a low volume car, the die costs could still easily run over $1M. While the rolls for a roll forming operation are not that expensive, it is likely that a whole line would be required because roll formed UHSS bumpers would be a new application.

Finally, for some cars, the goal is to make them as inexpensive as possible. The UHSS bumper will not be less expensive than a weaker bumper made of low gauge mild steel. Therefore, the UHSS bumper is not likely to penetrate this segment.

Automotive Company	Total Market	Design Limitations	Cost Inelastic High End	Low Volume	Cost Elastic Low End	*Potential Market
Rover	6,000	30%			25%	3,150
Ford	19,200	70%				5,760
Opel	19,800	70%		25%	10%	4,010
BMW	6,600	70%	25%			1,485
Audi	3,000	70%	75%	0%		225
Volkswagen	22,800	70%		25%		5,130
Volvo	3,000	30%		25%		1,575
Honda	6,000	70%				1,800
8 Company Composite	86,400	66%	5%	13%	4%	23,135
Scale to All Europe	160,800					43,056

Notes:
1. All numbers in metric tons of steel
2. All %'s represent portion of total market not suitable because of stated limitation
*3. Assumed covariance of variables = 0
4. Assumed 2nd half of market not surveyed has similar profile

Table 5 - Potential Market

3.2.3 Available Market

The *available market* is the potential customer of an UHSS bumper whom Indiana is capable of serving. Some customers might be able to use an UHSS bumper, but Indiana Steel might not be able to meet their needs for reasons unrelated to the product specifications. By adding this caveat we eliminate some sales primarily as a result of two factors. Some customers want to do bumper manufacturing internally - typically at a stamping facility. The stamping facility may not be interested in an investment in roll forming equipment. This will result in the assembly facility being unwilling to work with Indiana Steel. Similarly, the engineers at the auto company may desire to use UHSS, but the purchasing department may discourage or forbid such an arrangement. This is not unreasonable since purchasing groups in general tend to discourage the use of a single source supplier which Indiana would most likely represent. Even worse, Indiana Steel would not even be a domestic single source.

Since Euro Steel has a UHSS product line, it is possible to discuss dual qualification of products to eliminate the single sourcing issue. However, Euro Steel and Indiana's product lines are not identical, increasing the effort required to qualify both Euro Steel and Indiana. Dual qualification would also make Indiana more vulnerable to Euro Steel potentially stealing market share. For the purpose of this study, working with Euro Steel is not considered in terms of defining the available market.

Automotive Company	Total Market	Potential Market	In-house only does stamping	No Single Source	*Available Market
Rover	6,000	3,150			3,150
Ford	19,200	5,760			5,760
Opel	19,800	4,010	60%	50%	802
BMW	6,600	1,485			1,485
Audi	3,000	225			225
Volkswagen	22,800	5,130	20%	20%	3,283
Volvo	3,000	1,575			1,575
Honda	6,000	1,800			1,800
8 Company Composite	86,400	23,135			18,080
Scale to All Europe	160,800	43,056			33,649

Notes:
1. All numbers in metric tons of steel
2. All %'s represent portion of potential market not suitable because of stated limitation
*3. Assumed covariance of variables = 0
4. Assumed 2nd half of market not surveyed has similar profile

Table 6 - Available Market

3.2.4 Market Segmentation

Market segmentation is the process of dividing up the available market into groups, each of which represents a set of customers looking for similar product / service attributes. For Indiana Steel the key attributes that customers demand are local presence and service level. These are key because of the significant effort required by Indiana Steel to establish a presence in different locations in Europe and provide services to overseas customers.

3.2.4.1 Service

Auto company service requirements can generally be sorted into one of three levels of service. For group #1, low maintenance, the automotive company plans to do manufacturing in house and views the steel supplier as a commodity seller. For groups #2 and #3, moderate and high maintenance, the steel company is expected to help the Tier 1 player in performing the services shown as requirements. The work required could be greatly affected by the sophistication of the Tier 1 supplier.

Service Requirement	Group 1: Low Maintenance	Group 2: Moderate Maintenance	Group 3: High Maintenance
JIT delivery	NA	Yes	Yes
Design Capability	NA	NA	Yes
Design Advice	NA	Yes	NA
Testing Capability	NA	NA	Yes
Prototyping	Yes	Yes	Yes
Manufacturing Assistance	NA	???	Yes

Table 7 - Service Level Definitions

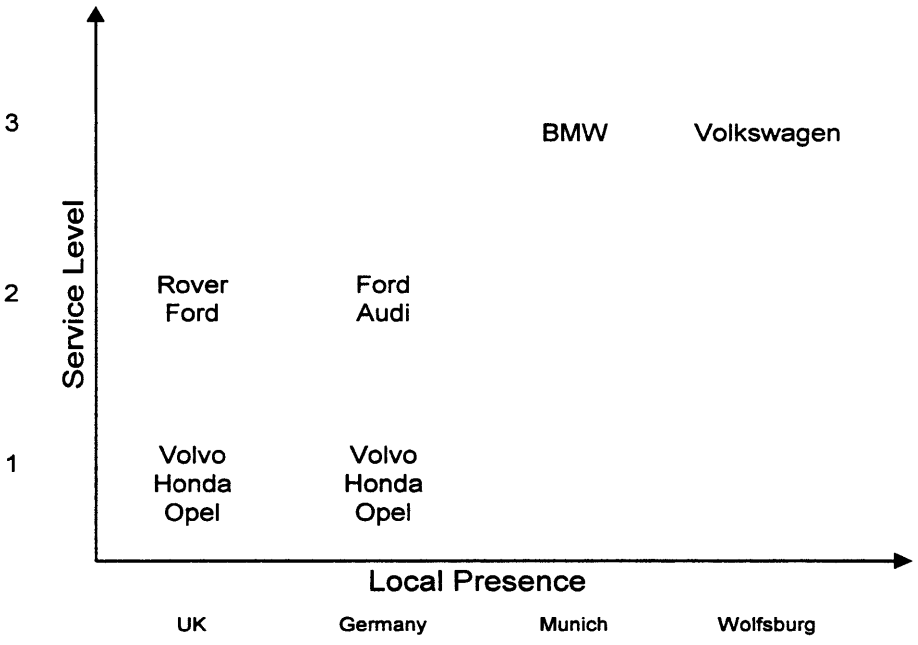
3.2.4.2 Local Presence

In the event that Indiana is asked to provide a significant level of service similar to a group #3 service package, or in many cases a group #2 service package, the expectation of the customer would be to have the supplier have a local presence. This means different things to different automotive customers. It probably means domestic technical service support in the event of quality issues in manufacturing. In some cases it means having a group of people a short distance from the assembly plant (<50km) who could work with the customer as needed. Short trips to the site, as needed, could also be made.

3.2.4.3 Grouping by Attributes

To identify different market segments we graph the different companies by the level of service required and their local presence requirements. The local presence requirements are simply

shown as Germany, England, or Specific Site Required. If a company does not have a requirement that suppliers have a local presence, they are listed under both Germany and England, indicating that either option is acceptable. Moreover, if a company has level 1 service requirements, location is also not an issue. Therefore, we have established a "No Local Presence" segment where location can be anywhere. This means potentially no European Tier 1 suppliers are used, as well as potentially several of them being used. This is possible under the service level 1 definition because no geographic restrictions are made. The results are shown below.



Major Market Segments (Local Presence/Service Level):

UK#2:	Germany#2:	No Presence#1:
Volvo	Volvo	Volvo
Honda	Opel	Honda
Ford	Ford	Opel
Rover	Audi	
Opel	Honda	

Wolfsburg#3:	Munich#3:	Multi#2:
Volkswagen	BMW	Volvo
Volvo	VOlvo	Opel
Opel	Opel	Ford
Ford	Ford	Audi
Audi	Audi	Honda
Honda	Honda	Rover

Figure 12 - Market Segmentation by Service and Geographical Location Requirements

Table 8 - Market Segments

Segment Name	Service Required	Local Presence Required	Customers	Avail Market
UK#2	**level #2**	**UK**	**Volvo** **Honda** **Ford** **Rover** **Opel**	**13,087**
No Presence #1	**level #1**	**NA**	**Volvo** **Honda** **Opel**	**4,177**
Germany#2	**level #2**	**Germany**	**Volvo** **Opel** **Ford** **Audi** **Honda**	**10,162**
Volkswagon	level #3	Wolfsburg	Volkswagon Volvo Opel Ford Audi Honda	13,445
BMW	level #3	Munich	BMW Volvo Opel Ford Audi Honda	11,647
Multi #2	level #2	UK + Germany	**Volvo** **Opel** **Ford** **Audi** **Honda** **Rover**	13,312

*note - Ford has locations in both UK and Germany. Because of this, and because this company has strong ties among global locations, we are assuming that both Ford sites may receive level 2 service from either Germany or the UK.

The above analysis allows us to divide the market into six market segments. Companies that require level 1 service are listed under all segments, regardless of auto company location. Auto companies with level 2 service level requirements, who are located in the same countries as companies requiring level 3 service, are also listed in those corresponding segments. The

"Available Market" column is simply the sum of the available markets of the segment's constituents. At this point, we have not identified the attractiveness of these segments or how the value chain can be constructed to serve these markets. That analysis will be done in Chapter 4.

3.3 Competition (Tier 1)

- The price/performance of an UHSS bumper solution for the European market would be competitive with Plannja and Al extruded solutions.

On the high end UHSS finds itself competing with Al and composites as a high strength, low weight bumper solution. At the low side, it must compete with stamped steel and plastic bumpers. In some cases, a manufacturer in Europe may get away with not even using a rear bumper. Cost and weight become key performance benchmarks for bumpers in Europe as well as in the US. To better understand the competitive position of a UHSS against some of these competitors, we have developed a model to predict bumper reinforcement beam costs. The model makes adjustments for weight differences among different types of materials. Current market share, cost data from the model, and non-cost considerations are discussed in this section to understand the UHSS reinforcement beam's position among the competitors.

3.3.1 Current Market Share

The most popular material / process choice for bumpers in Europe is stamped steel. This is partly a result of the strong stamping infrastructure in the European automotive industry for component parts. Still, a number of other alternatives exist in the market place. These are used predominately for lowering weight or reducing the high capital costs associated with stamping steel. One of the automotive companies interviewed indicated a reluctance to consider non metal options because of inferior performance in high speed crashes. However, this is not a universal concern. A rough estimate of current market share for different material / process options is shown below. This data is based on our impressions from talking with the eight automotive companies surveyed and is therefore subject to significant uncertainty. Nevertheless, it gives some indication of the current market in Europe. It should be noted that most of the companies we talked to expressed interest in processes not currently being used for bumpers. These are also listed in the table below.

Table 9 - Current market share of competitive materials

Reinforcement Beams	Current Market Share
Stamped steel	> 50%
Extruded Al	20%
SMC - plastic	15%
Rolled Form Steel	>5%
Stamped Al	5%
Composites	< 5%
Future Possibilities: UHSS, Plannja, Hydroformed, Welded Blanks	0%

3.3.2 Cost / Weight Performance

We are able to apply our manufacturing cost model to various technologies and materials to provide estimates for the costs of stamped steel, extruded Al, stamped Al, Plannja, and UHSS reinforcement beams. However, all automotive manufacturers have indicated their interest in weight reduction. To take this into account we adjust the cost of the bumpers by $3 per Kg , the median value we were told by European automotive companies.

The cost comparison after adjustment for weight is shown in Figure 13. This indicates that an UHSS bumper in the European automotive market has the potential to add value for the car companies. Appendix A shows the variables going into the competitive materials cost model and a detailed description of the underlying assumptions built into the model.

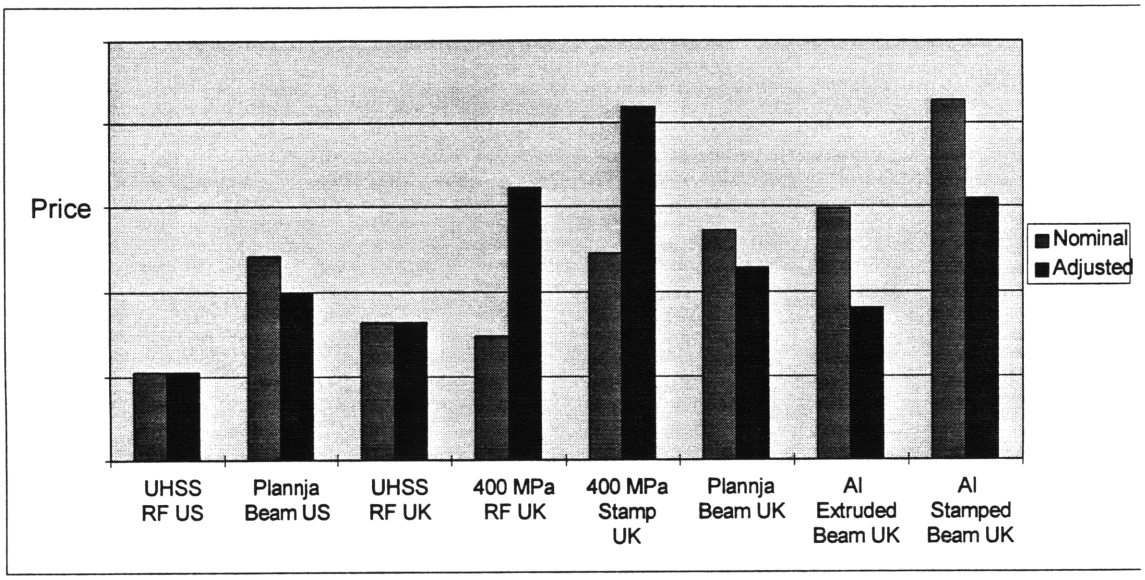


Figure 13 - Cost Estimates for Competitive Materials - Adjusted

3.3.3 Other Considerations

The understanding of competition is not simply revealed by looking at the competitive materials cost model. The model shows that the cost of stamping, the predominant method for reinforcement beam production, is very expensive. However, there are three primary sources of error in this analysis. Firstly, the automotive company may have excess stamping capacity and so they might regard the capital investment in stamping presses as sunk costs. Secondly, if the car company wants to have the lowest cost acceptable bumper they can afford, taking advantage of the low European regulations, they might use a thin gauge material so that it is not possible (because of stiffness concerns) for the UHSS bumper to be produced any thinner. The model assumes the UHSS bumper is built thinner, in line with its higher ultimate yield strength. The strengths and thicknesses of two different steels are related by the equation

$$s_1 t_1^2 = s_2 t_2^2$$

A thinner UHSS material would have strength equal to that of a thicker low tensile strength steel. Finally, if a weaker bumper is needed, a really simple design that minimizes the die costs associated with stamping can be used.

Al extrusion and Plannja are a little more expensive than UHSS, but not by much. A hidden cost to UHSS, however, could be the work associated with the design that addresses the manufacturing design limitations to roll forming. While we are assuming that the application can eventually accommodate the UHSS process, part of the UHSS available market, it may be less rework for engineers to use extruded Al or Plannja, which are much more accommodating and might be useable over a wider range of the car companies' vehicle designs.

The stamped Al beam does not seem competitively priced. It is likely that it is only used when the bumper design can not accommodate the limitations of extruded Al and low weight is very important. These would not be applications for the even more limited UHSS beam process. Our model does not extend to assessment of non-metallic materials such as plastic or composite bumpers, so it is difficult to assess the UHSS beam in comparison to these material choices.

3.4 Channel Environment (Tier 1)

- Distribution requirements are JIT
- Inter-Europe transport costs higher than US, which might compel auto company to push for local supplier

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We define the Tier 1 Channel as that method(s) by which material or parts are transported from the Tier 1 supplier to the auto company. There are two major scenarios:

1. Tier 1 supplier is US based - that is, manufacturing is done in the US and the part is transported overseas
2. Tier 1 supplier is European based - that is, manufacturing is done in Europe and intercontinentally shipped to the auto company.

Certain aspects of the channel environment are altered depending on which scenario is examined. These aspects are more evident in the logistics section of the channel environment.

3.4.1 Distribution

The auto company distribution requirements of their suppliers can be summarized very succinctly: just in time delivery. The method by which this is achieved is not important to the auto company in most cases.

The relationship between Tier 1 suppliers and auto companies is relatively strong. Within certain geographical operations, i.e. Ford England, there is one or a short list of Tier 1 suppliers with whom the auto company will do business. In other words, they will contract exclusively with a particular supplier or set of suppliers, and if new projects develop, those select suppliers will be the only ones considered for the job. Thus, the distribution channels being used would already have been long established. Any new Tier 1 supplier to the auto company would likely have to integrate themselves into the distribution system.

There are different variations on the basic supply chain that need to be researched further, but the more likely scenarios are those that geographically locate all sections of the chain in the same area. The geographical proximity is very important to players closer to the end of the supply chain, i.e. auto companies, where JIT delivery is the standard requirement.

3.4.2 Logistics

In this section, we will describe the transportation options for the Tier 1 to auto company channel. As a US based Tier 1 supplier, the options for shipment are limited to one - containerized shipment. One basic scenario would be as follows:

1. Accumulate completed bumpers at Tier 1 location.
2. Load bumpers into containers (most likely 40 foot high cube containers)
3. Ship containers to port
4. Overseas containerized shipment to Europe
5. Unload at central warehouse in European port
6. Direct land transport to customer

Besides the cost of transportation, there are also varying duties charged to incoming overseas shipments, depending on the nature of the product that is shipped. A breakdown of different duty charges as they apply to bumper reinforcement beams is in Appendix B.

If the Tier 1 supplier is a European company, then the overseas options become unnecessary. What does become important, however, is the inter-Europe transportation. This logistical question is important as well to the US Tier 1, in that they must choose a point of entry to Europe that minimizes the total of overseas transportation, duty, and inter-Europe transportation costs. Depending on the origin and destination points in Europe, the cost of transportation can vary. In most cases, truck or train would be the method of transportation used, and the parts would be transported direct to the customer. However, a local warehouse might be used if a Tier 1 is located in a different country than the customer. Appendix B gives an indication of charges for various origin and destination points in Europe. Overall, cost of transportation in Europe is more than twice as expensive as in the US.

3.5 Tier 1 Assessment

- Tier 1's are either lacking in technical expertise or European presence, both of which are very crucial to the Tier 1's ability to penetrate the UHSS bumper market.
- Several roll formers are willing to attempt forming higher strength steels such as UHSS
- Raw material supplier would be expected to use the distribution channels dictated by the Tier 1

There are two dimensions to the Tier 1 assessment: do they want to be in the automotive bumper supply chain, and do they want to work with Indiana Steel if they decide to be in the market? In analyzing this environment, we have chosen to pick two symbolic cases, a Tier 1 supplier in the US and a Tier 1 supplier in Europe, as the environment differs significantly depending on the country from which the Tier 1 is based. The framework by which the Tier 1's will be analyzed is as follows.

1. List of variables which are used in determining whether or not the Tier 1 is suited for the UHSS bumper business and/or interested in working with Indiana Steel

2. Matrix of Tier 1 players, grouped by geographical location

3.5.1 List of Variables

The areas to consider for the Tier 1 supplier are described as follows:

1. Financial Risk - the risk involved to the Tier 1 in terms of monetary value. Is the company in danger of insolvency if the venture fails or is less successful than predicted? Does the venture have a positive NPV?
2. Business Risk/Strategy - is the business in line with the overall company strategy?
3. Core Competency - does the new business effectively utilize the competencies which the Tier 1 has already developed?
4. Culture - is the company culture one that would support this type of new business?
5. Capacity - does the company have the equipment or service capacity to support the new business?
6. Customer Relationships - can these relationships be built, or do they already exist, and can they be strengthened through the new business.
7. Future Opportunities - what potential new business opportunities are available as a result of the new business
8. Margins - Are the margins high?

3.5.2 US Based Tier 1 Suppliers - US-A symbolic case

We analyze the situation of a Tier 1 roll former in the US with respect to the eight variables outlined in the previous section

1. Financial risk - Current domestic bumper business has not been profitable. Poor product yield and equipment up time may be contributing factors.

2. Business Strategy/Risk - This company has previously expressed interest in overseas activity.

3. Core Competency - The company currently has several US models for which they roll form. To this business they lend the skills of mass roll forming manufacturability. The European market would not be much different in terms of skill sets being used. The one exception,

however, would be if the bumper shapes are much more complex than what the Tier 1 is used to forming.

4. Culture - There is a difficulty achieving cultural understanding between the 2 different countries. US-A has never had any overseas business. As was mentioned previously, European auto manufacturers tend to desire local suppliers. Without a European presence, US-A is at a disadvantage in understanding the culture of European auto companies.

5. Capacity - Currently there are 4 roll forming lines at the US-A facility. They appear to have available room for additional lines, and the current lines are not fully utilized. There may be some possibility for rafting rolls for other bumper designs. US-A also has been actively quoting the European transplants of their domestic customers, another indication of available capacity to assume new business.

6. Customer Relationships - US-A's current customers are US based automotive customers. They have the ability to leverage off of these relationships to gain visibility in the European market through their customers' European divisions. US-A does not have existing relationships with European based auto companies, which puts them at a strong disadvantage with respect to European Tier 1's, who already have name recognition or existing business with European auto companies.

7. Future Opportunities - The prospect of future business opportunities is available to US-A, provided they are able to break into the European market. There are 13.4 million cars built in Europe every year. This is a significant number of cars (and, hence bumpers) that could potentially be produced by US-A.

8. Margins - As mentioned before, there are rumors that the US-A business is for sale. Moreover, the impression is that the company is not making money from the bumper reinforcement beams. As will be described in the competitive pricing model, the manufacturing costs of producing roll formed bumper reinforcement beams face competition from alternative materials and processes. This is a highly competitive market, where oftentimes suppliers are pitted against each other by the auto company to get the least expensive quote. Another

possibility for the lower than desired margins is poor manufacturing efficiency of the facility. With the added service cost of supporting Europe, the margins would likely get worse unless scale efficiency or higher prices could be supported.

3.5.3 European Based Tier 1 Supplier - Euro-1 symbolic case

We shift perspective to the symbolic case of a European Tier 1 Supplier. The Tier 1 chosen for this case is a UK based roll former. The environment surrounding this Tier 1 is described.

1. Financial Risk - It is a currently profitable business. The size of the new business is relatively small in proportion to the rest of their businesses

2. Business Risk/Strategy - Capital expenditures for a system that forms UHSS is $2M. The company would not likely make that investment until they have secured some business. Roll forming is in general a more profitable business endeavor for them

3. Core Competency - The rollforming of ultra high strength steel has not been previously done by a European Tier 1 supplier. However, they have made roll formed bumper reinforcement beams out of milder strength steel. There is uncertainty as to whether they would be able to transfer the roll forming expertise they already have to the roll forming of ultra high strength steel.

4. Culture - The European presence of the Tier 1 supplier is a big advantage to understanding of the culture in the European auto company.

5. Capacity - The size of the business is not that large compared to their existing business. It is very likely that additional capacity could be found.

6. Customer Relationships - Euro-1 currently sells roll formed parts to Ford, Jaguar, Rover, Opel, and VW. They have name recognition in their European operations and might be able to leverage off of them into new deals.

7. Future Opportunities - Initially, there is greater potential opportunity as a European Tier 1 supplier. This is because of the European auto company's heavy emphasis on geography. A Tier 1 supplier that is located in close proximity to the customer is inherently at an advantage for achieving future business.

8. Margins - Healthy overall, roll forming is less competitive than stamped parts.

3.5.4 Matrix of Tier 1 Suppliers

A description of the Tier 1 suppliers and their positions on the eight variables is provided in the matrix that follows. In addition to the variables that determine the Tier 1's suitability and desire to be in the UHSS European bumper market there is the question of whether or not they would be willing to purchase UHSS from Indiana Steel given they have chosen to be in the market.

Table 10 - Tier 1 Suppliers and Positions on Variables*

Variable	US-A	Euro 1
financial risk	not enough information gathered to assess	appears to bear no financial risk
business risk/strategy	in line with company desire to go overseas	appears to be in line with company strategy
core competency	main business is in stamping	core business is in roll forming
culture	strongly US centered culture	European culture
capacity	available	unknown
customer relationships	has limited European customer contacts	most European contacts are located geographically close to them
future opportunities	unknown	unknown
margins	unknown	significant
willing to buy UHSS from Indiana Steel	yes	yes

*typical matrix - not all players included because of incomplete data

3.6 Competitive Environment (Tier 2)

- There is only one European steel company (Euro Steel) that currently offers an ultra high strength steel
- Because of the high cost of shipping from Sweden to continental Europe, the cost of steel transportation to most European customers is similar whether he buys from Euro Steel or imports from Indiana Steel (Volvo being the exception)
- Other European steel companies have the capability to set up annealing lines for production of ultra high strength steel, but the lead time to develop these products would likely be two years or longer.
- Low market potential for ultra high strength steel has discouraged European steel companies from offering ultra high strength steel

3.6.1 Current UHSS Market in Europe

In this section we define the UHSS market in Europe. Currently there are no UHSS bumpers in Europe. However, there is one Japanese transplant in Europe that has specified an UHSS bumper for one of their new cars. Other auto companies have considered UHSS bumper proposals in the past that were not selected. UHSS is also sold in small volume for a number of other applications, but it is generally an unknown entity in the European market.

3.6.2 UHSS Current Producers

There is one company in Europe that makes an ultra high strength steel. As mentioned in previous sections, Euro Steel is a steel company in northern Sweden that offers a steel product line, Docol, that is comparable to Indiana's ultra high strength steel. Their current volume of ultra high strength steel production is 10-15 thousand tons of ultra high strength steel for 1995. They have plans for expanding their market and have approached Indiana for knowledge about the potential ultra high strength steel market. Below is a description of Euro Steel's strengths and weaknesses compared to Indiana Steel's.

Table 11 - Euro Steel Strengths and Weaknesses

Euro Steel Strengths	Euro Steel Weaknesses
technical knowledge in metallurgy	expensive inter-Europe shipping costs
very good at educating the potential customers by conducting seminars	no expertise in early involvement with automotive companies
European location	less experience with bumper design than Indiana

3.6.3 Emerging Trends

The essential equipment needed to produce ultra high strength steel is a high temperature/high cooling rate continuous annealing line, which some European steel companies have. This alone, however, does not guarantee that these companies could start producing UHSS because there are a number of potential equipment limitations that might prevent successful implementation. The transfer over to UHSS could also be difficult in that the effect on the equipment of running the UHSS might cause problems for other products such as exposed parts for the automotive industry. Currently only Euro Steel offers any UHSS products in Europe. Even if other players were to enter the market, the product development cycle is likely to take at least two years and facilities conversion would be expensive.

There does not seem to be an urgency for the European steel companies to offer ultra high strength steel. Euro Steel is the only European source for UHSS currently and in the near term.

3.7 Tier 2 Assessment

- Would be the second steel company that offers ultra high strength steel in Europe
- Infrastructure for distribution in Europe undeveloped
- Lack of developed relationships with European contacts
- Limited resources for servicing new potential markets. Company is currently expecting and planning for significant US expansion.
- New corporate directive calls for operational excellence over product leadership or best total solution

3.7.1 Company Assessment

We have compiled a list of issues that we feel are important in assessing the Tier 2. The company environment and their suitability for entering the new market can be analyzed by looking at eight different perspectives: financial risks, business/strategic risks, core competencies, corporate culture, capacity constraints, customer relationships, potential future opportunities, and new product margins. Each of these perspectives as they relate to Indiana Steel is described.

3.7.1.1 Financial Risk of Market

There is some financial risk associated with entering the European UHSS bumper market, depending on the strategic approach Indiana Steel chooses. In the worst case, Indiana spends money on technical service manpower and invests a small amount on establishing distribution channels where there is no steel to be sold. The best case would be largely dependent on the amount of steel sold. The break-even point for a positive net present value is indicated in the financial model, which will be discussed in section 4.5.

3.7.1.2 Business/Strategic Risks

The new European business could potentially pull resources away from the US, where they are badly needed to service the domestic market.

3.7.1.3 Core Competencies

Indiana Steel's strengths in the current domestic market include

- Early Involvement with customers on steel applications
- Technical service
- Unique processing line that is currently manufacturing what other companies can't manufacture
- Leverage of steel company to subsidiary distribution company
- They are the only integrated steel company that has an extensive research and development department

3.7.1.4 Company Culture

The Indiana Steel corporate culture is very conservative, particularly within the steel company. The international group and Frank's Warehouse (distribution arm) are less so.

3.7.1.5 Capacity for New Business

There are three aspects to consider in Indiana's capacity for new business : capital resources, additional utilization of current facilities, and additional labor resources

Capital resources - Being in a mature industry where profits are marginal, Indiana Steel does not have the resources to construct a manufacturing facility in Europe. Rather, the most feasible expansion plan is to produce in the US facility and export overseas.

Utilization of Current Facilities - As mentioned before, the continuous annealing line is the process by which ultra high strength steel is made. The Indiana Steel CAL line was built in 1983 specifically for the capability to make ultra high strength steel. The capacity of the line is 350,000 tons per year. Currently, 20% of the products run on the line are ultra high strength steel. Much of the remaining 80% of products are very low margin and don't cover the capital cost of the investment. It is therefore a logical business decision for Indiana Steel to shift product to ultra high strength steel, provided they find a market for it.

Labor Resources - In terms of labor, approaching the new market involves additional labor for support activities such as technical service and sales. The steel company is currently in a downsizing mode. Hiring employees for new ventures is counter to current company policies. A possible approach would be to re-prioritize the current workforce to handle extra requests for service.

3.7.1.6 Customer Relationships

Indiana Steel currently has no European UHSS business, and limited orders for other steel grades. As a result, they do not have an established customer base of relationships on which to leverage. However, they do have well based contacts in the US market, at all the Big 3 companies.

3.7.1.7 Potential Future Opportunities

Indiana Steel could gain a head start on learning information about technologies that are introduced in Europe, much earlier than many of their domestic rivals will be capable. There are

also possible niche markets that Indiana could assume once they have a foothold on the European market. There is also a push for global suppliers from many of the multi-national firms so that Indiana Steel might gain an advantage from this capability. Indiana Steel also has a relationship with a trading company that could be leveraged for inter-continental trade.

3.7.1.8 Margins

Margins in the steel industry are generally low. The UHSS line, however, is one of the exceptions to this trend. This is largely because of the differentiated nature of the product.

3.7.2 Corporate Direction

- Corporate strategy = Operational excellence
- Mature industry; limited resources for new projects

The steel company recently has adopted a policy of operational excellence. Operational excellence means the following.

- Achieves preferred supplier status through consistent Quality and Delivery. Achieve best in class delivery and quality while maintaining parity in service.
- Concentrates on a limited mix of product that the organization knows how to make and sell.
- Optimizes assets through the consistent improvement of manufacturing capabilities
- Capital expenditures prioritized for improved asset utilization.
- Focuses on the manufacturability of existing products. Develops new products only in a defensive posture.
- Depends upon centralized functions to support internal customers
- Requires an organization that operates in a state of control on an ongoing basis and is free of operational disruptions.
- Requires the avoidance of specific process and schedule changes.
- Develops and executes non-capital solutions to problems and opportunities.
- Utilizes a Total Quality approach to all elements affecting operational excellence

This recent policy has directed the company towards limiting their ultra high strength steel product line to those that have been produced well in the past.

The steel industry is a mature industry. Because of the nature of the industry many steel companies are going through financial difficulties. Indiana Steel is no exception. They are finding it difficult to compete in an industry where much of the products are commodities. In fact, in 1997 they laid off approximately 500 people across the board.

Technical service for the US business is stretched. International prospects are served by a small international group. Their goal is to follow and serve their customers internationally by guaranteeing a quality source of material world wide. However, setting up this mission has centered more on materials processing and distribution capability than on selling US produced steels abroad.

3.8 Public Policy Environment (Tier 2)

- Does not appear to be a major concern
- One possible concern may be local steel supplier requirements that some countries may have (i.e. Portugal)

As of the writing of this paper, there are no known policies regarding the composition of steel.

3.9 Channel Environment (Tier 2)

- Most large distribution houses in Europe are controlled by European steel companies.
- Customers require JIT delivery, preferably through their current distribution house.
- There are three methods for shipping steel overseas: container, lash barge, and vessel

3.9.1 What is Needed to get from Point A to Point B

The process by which raw steel gets to a Tier 1 supplier is very involved. There are different permutations for getting from Point A to Point B but the basic process is as follows.

Steel coming out of the continuous annealing line is sent to a domestic distributor. Here it is processed. Processing includes slit to width, cut to length, trim, and packaging. Sometimes it is sent out and coated with a corrosion inhibitor, then brought back to the distributor before packaging. If the steel is to be shipped overseas there are several choices of shipment. The three options are containerized shipping, lash barge, or vessel. Figure 14 shows a general distribution path for getting steel to Europe.

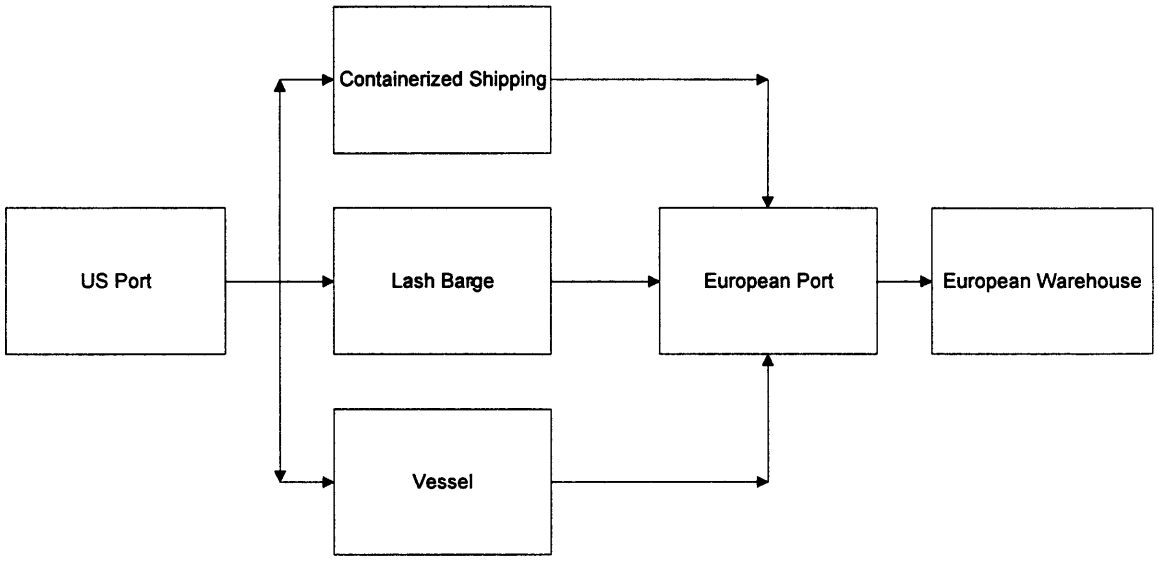

Figure 14 - General Distribution Path for Getting Steel to Europe

3.9.1.1 Processing

The processing requirement for steel prior to delivery to a Tier 1 would be similar to what is required in North America. The steps involved in processing - slit, cut to length, and trim - were described in section 2.4.3. A US processor would complete these same steps for a European application. If a European processor were chosen, some additional research in their capabilities would need to be done. This is mainly to ensure that they have proper knives for cutting UHSS. UHSS tends to slowly dull the edges of standard knives. Handling operations for strapping and unstrapping the steel might also need to be modified because of the greater safety hazard associated with the high springback of UHSS. If the processor is not already equipped with the special knives, there may be some lead time in ordering them.

3.9.1.2 Shipping

The three methods of shipping steel overseas are container, lash barge, and vessel. A description of these methods is given below. More specific details regarding shipment methods are available in Appendix B.

1. Container

Containerized shipping is most efficiently done in increments of 18 metric tons. Delivery time is typically 3 weeks. It is the method of shipping that is most economical for smaller shipments.

2. Lash Barge

A Lash barge stands for lighter aboard ship. For volumes close to 390 metric tons, the lash barge is approximately 30% less costly per ton than containerized shipping. Delivery time is 4-5 weeks.

3. Vessel

Vessels are most effectively used for very large shipments, 5000 metric tons or more. The cost using this method of shipping is about one half that of containerized shipping. The disadvantage of this method, however, is that the frequency of shipments required is very low. There are also many winter months where vessels can not ship out of Indiana's port.

3.9.2 Tier 1 Relationship with Distribution Houses

The supply chain for Europe varies slightly from the US/North American model. The basic model is as follows:

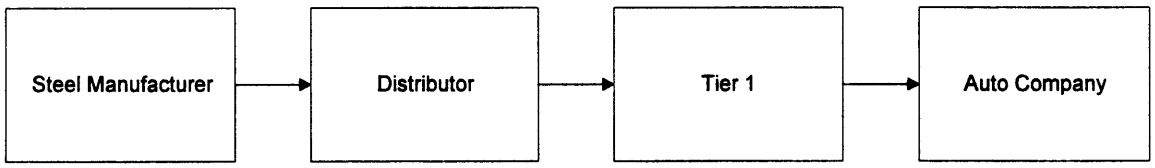

Figure 15 - Basic US-Europe Supply Chain

- The distribution houses in Europe are typically associated with a steel company. To sell steel to the auto company or Tier 1 supplier, an outside steel manufacturer needs to work through the distribution house normally used by the customer. As a result, higher distribution rates are charged to the outside steel manufacturer because there is no alternative infrastructure in place.
- The relationship between Tier 1 suppliers and auto companies is relatively strong. Within certain geographical operations, i.e. Ford England, there is one or a short list of Tier 1

suppliers with whom the auto company will do business. In other words, they will contract exclusively with a particular supplier or set of supplier, and if new projects develop, those select suppliers will be the only ones considered for the job.

- There are different variations on the basic supply chain that need to be researched further, but the more likely scenarios are those that geographically locate all sections of the chain in the same area. The geographical proximity is very important to players closer to the end of the supply chain where JIT delivery is the standard requirement.

3.10 Confidence Interval

The information collected in the European study is subject to different degrees of uncertainty. These uncertainties are mainly due to insufficient data, but for the purposes of reaching some resolution, assumptions needed to be made.

- In considering the size of the market or possible segmentation strategies, we are neglecting replacement bumpers. Replacement bumpers could represent increased production at the auto company beyond the quantity needed for new cars. It might also represent some continued business beyond the duration of the particular automobile in production. It is also possible that third parties are responsible for dealing with replacement bumpers and that their design or manufacturing process is not dictated by the design of the bumper for new cars. As such it could represent an independent market segment.
- The seven companies that we visited are not a balanced cross-section of the customer base. They were geographically located in England, Germany, and Sweden and comprised 50% of the auto market. The car companies Peugeot, Renault, and Fiat in Italy and France represent a significant low end car market segment which was not represented by any of the companies in our study.
- Information about competitive technologies change every day. It is likely that new manufacturing technologies or products are being developed in Europe rapidly. These new technologies are not necessarily perceived by the competition or outsiders quickly enough to be up to date, Competition needs to be continually investigated, as it is always changing. In particular with hydroforming technology, where it is viewed by many auto companies as

being the future of steel forming, more information needs to be collected to gauge the threat of the new technology.

4. Strategy Development

Using the information gathered and organized in section 3, we are able to formulate a business strategy for entering a new market as a Tier 2. We now apply the framework described in the introduction of this paper to the UHSS case.

4.1 Determine Attractive Markets

In section 3.2 we identified six market segments. In this section we will delve deeper into the method of determining the relative attractiveness of each of these segments. We also add to this list of segments one more option - no European market. This option can not be ignored given Indiana's aggressive US expansion plans coupled with the threat posed by Plannja's increased presence in the US, discussed in chapters 1 and 2 respectively.

Kotler provides a good starting point for evaluating these seven defined segments. His three criteria, described in the introduction, are

1. segment size and growth
2. segment structural attractiveness (do you possess a competitive advantage?)
3. fit to company objectives and resources

Segment Size and Growth

The available market size of each segment was discussed in Section 3.2 on Tier 1 Consumers. This addresses Kotler's criteria #1 for determining market attractiveness. Growth potential of the various markets is more difficult to quantify. This is an area that would require further investigation to better define. For the purposes of this thesis, we will assume that each segment will remain at its current size.

Segment Structural Attractiveness

Kotler's criteria # 2, the determination of structural attractiveness, can be interpreted to mean "how likely is the segment to purchase an ultra high strength steel bumper." To address this, we assign a probability to each auto company's likelihood of purchasing UHSS for a bumper. This is multiplied by the available market to obtain an expected market. Again, these probabilities are

not easy to quantify, but for the purpose of working the example through the framework, rough guesstimates have been made.

Fit to Company Objectives and Resources

The third measurement of attractiveness we made was through the use of optimization techniques. Similar to linear programming, the different auto companies that comprise each segment and the locations dictated by these segments are translated into a score which consists of a "pain value" for serving the particular market, and utilizes the probability factor introduced in criteria #2 to adjust for total expected volume for at each auto company. The pain value is an indication of the fit to the company's objectives and abilities. The values we use in the example are disguised numbers. They are intended to give a rough approximation of the value of hardship for the Tier 2 presence in different locations, as well as an indication of the hardships encountered for different service levels.

Additional Factors to Consider

To Kotler's three criteria we have added the following additional factors to consider. The evaluation of these factors will evolve through the course of the five step strategy development. We state here at what points in the process each of the steps may suitably be addressed. The factors are described in order of evaluation as follows.

After Step 1

- Marketing/Sales factor - does this segment build on existing customer relationships?
- Coating/Corrosion protection factor - how do the corrosion protection standards of members of this segment affect the formation of the value chain? Do additional steps in the chain need to be added in order to accommodate the standards?

After Step 2

- Organizational Stress - will targeting the market segment cause undue organizational stress to the Tier 2 supplier?
- Single sourcing of Tier 1 or distribution channels - by choosing this segment as attractive have we limited ourselves to utilizing only one Tier 1 supplier or distributor?

- Politics - How will supplying to this segment be viewed by various interested parties, including other auto companies, Tier 1 suppliers, steel companies, and different functions within Indiana Steel? An example of where politics may play a factor would be in deciding the method of transportation to use for moving steel. Certain companies may have strong preference for a carrier. Also, the choice of Tier 1 could be very political. There are auto companies that have a strong affiliation with one or two Tier 1 suppliers and will refuse to work with outside vendors. The choice of the auto company to target is itself very political. A big automotive company with a presence in multiple markets may set a precedent for others to follow suit.

After Step 3

- Response time - how long it will take for the structure to be put into place and for the results of these structures seen.
- Learning Curve effects - what is some of the knowledge that is already had, and can be leveraged, versus what is completely unfamiliar territory without any foundations upon which to build.

Attractive Markets

For each of the seven segments as defined previously, a combination of one or more auto companies is paired with a certain geographical location or locations. The null set also is defined as a segment. Table 12 shows the Excel Spreadsheet matrix that was used. This matrix was filled in using the parameters set by the seven segments. For each segment a total volume, total adjusted volume, and "business value" are calculated. The example shown is for the UK#2 segment. The business value can be related to the value of just US market (no European business) which is zero. All of the business values are relative to this null segment value.

Table 12 - Excel Spreadsheet for Calculating Business Value for Attractive Segments

	Pain	3000	3000	3000	3000	2000	Locations		
	Selection		1	0	0	2	1		
Automotive Company	Use Company	Germany	England	Wolfsburg	Munich	Service	Volume	Probability	Adj Volume
Rover	1		1			2	3,150	0.5	1575
Ford	1					2	5,760	0.6	3456
Opel	1	1				1	802	0.5	400.95
BMW	0				1	3	1,485	0.6	0
Audi	0	1				2	225	0.6	0
Volkswagen	0			1		3	3,283	0.5	0
Volvo	1					1	1,575	0.65	1023.75
Honda	1		1			1	1,800	0.6	1080

Total Volume	13086.9
Total Adjusted Volume	7535.7
Business Value	**535.7**

Table 13 indicates the scores for each of the seven segments. According to these results the top four attractive segments are UK#2, No Presence #1, US Market Only, and Germany#2. The expected markets from each segment are 7536, 2505 , 0, and 6096 tons respectively.

Table 13 - Optimization Scores for Seven Segments

Segment Name	Service Required	Local Presence Required	Customers	Avail Market	Expect Market	Score from Optimization
UK#2	level #2	UK	Volvo Honda Ford Rover Opel	13,087	7,536	536
No Presence #1	level #1	NA	Volvo Honda Opel	4,177	2,505	505
US Market Only	NA	NA	NA			0
Germany#2	level #2	Germany	Volvo Opel Ford Audi Honda	10,162	6,096	-904
Volkswagon	level #3	Wolfsburg	Volkswagon Volvo Opel Ford Audi Honda	13,445	7,737	-1263
BMW	level #3	Munich	BMW Volvo Opel Ford Audi Honda	11,647	6,987	-2013
Multi #2	level #2	UK + Germany	Volvo Opel Ford Audi Honda Rover	13,312	7,671	-2329

Here we can evaluate the first two addendum factors to Kotler, the marketing/sales factor, and the coating/corrosion protection factor. As we look at the top three segments, we see that the UK segment consists of 2 companies with whom Indiana currently has North American business. This segment has potential to build on the existing Ford and Honda relationships. The auto companies included in the No Presence #1 segment could require minimal additional marketing, because companies in this segment have low service requirements. With the US Market Only segment, the same marketing/sales force would be used.

As far as coating requirements are concerned, all of the auto companies comprising the three most attractive segments do not require galvanized coating. Rather, some do require an e-coat or paint. This is a major difference between the requirements of the North American market and the European segments the Tier 2 could potentially target.

4.2 Value Chain Construction

In this step, we take the segments that have been found to be most attractive and theoreticize the types of value chains that might achieve selling to the market.

In terms of delegation of service/support required from each member of the value chain, we will divide between the three major entities - Tier 2, Tier 1, and auto company. Using our previous descriptions of level 1,2, and 3 service, this means, for example, that an auto company that requires level 3 service will not be delegated those services. They will be delegated to a combination of Tier 2 and Tier 1 supplier. Conversely, for an auto company that has a level 1 service requirement, those services/support may be fulfilled by either the auto company or the other two entities.

We also describe in this section the level of marketing or sales resources that are required from each of the three entities - who is responsible for what, and so forth.

General Value Chain

A general value chain for distributing steel to an auto company might look like this.

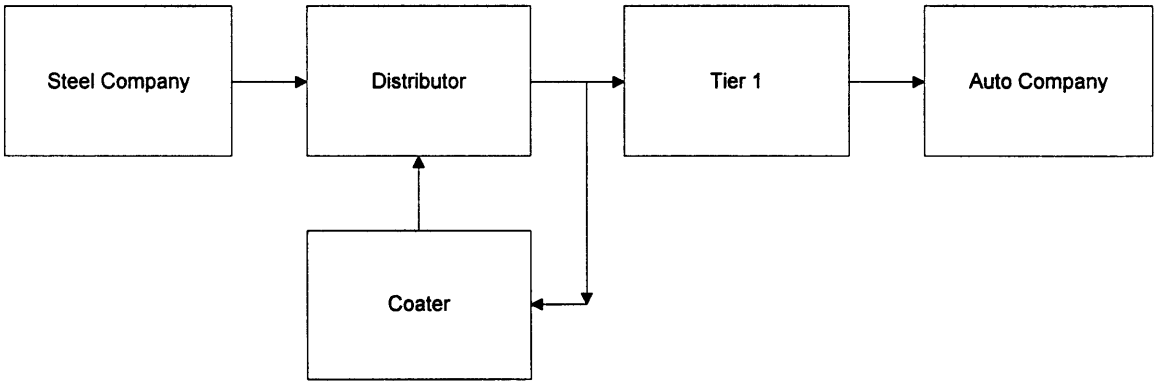

Figure 16 - General Value Chain for Distributing Steel to an Auto Company

4.2.1 Option 1 - Location UK, Service Level 2

For Option 1, location in the UK and level 2 service, the choice of distributor, Tier 1, coater, and auto company needs to be made optimally. One such chain might look like this.

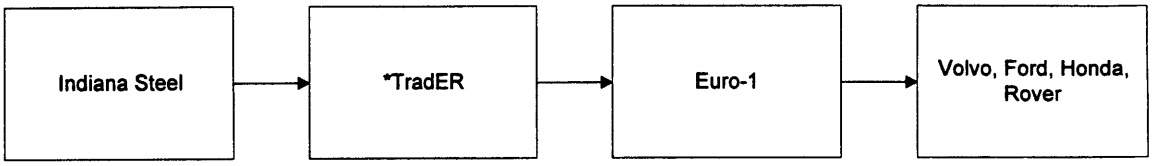

Figure 17 - Value Chain 1 for UK#2 Segment

*TradER is the international trading company used by Indiana Steel.

Any coating procedure would be accomplished by Euro-1, a Tier 1 supplier that has electrocoating capability and currently does it for many other products.

Tier 2 responsibilities

- provide steel coils to Euro-1 on a timely basis
- coordinate shipments with Euro-1 distributor
- provide some manufacturing advice - likely through visit on initial start up and subsequent teleconferences

Tier 1 responsibilities

- JIT delivery to the auto company from within Europe
- Design advice
- prototyping
- manufacture of the part
- coating/corrosion protection

Auto company responsibilities

- core design and specifications
- testing capability for parts

The marketing or sales responsibility would probably be a joint effort between the Tier 1 and Tier 2 suppliers.

Another value chain for Option 1 might look like this.

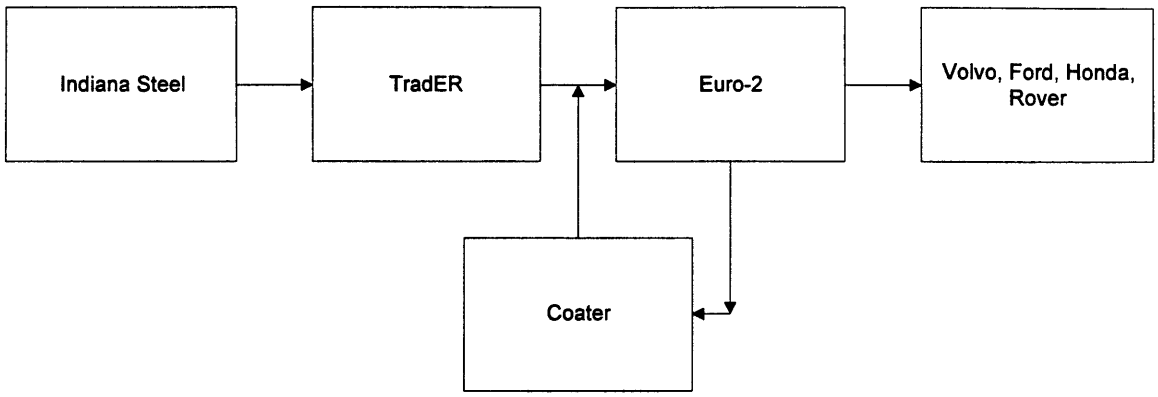

Figure 18 - Value Chain 2 for UK#2 Segment

In this value chain, the differentiating factor is the choice of Tier 1 supplier. The Tier 1 chosen in this example does not have coating capability. Moreover, they do not provide design advice, which the Tier 1 in the previous example does provide.

Tier 2 responsibilities

- delivery to UK using any means desired by Tier 2
- design advice to auto company, either in person, or by teleconference and fax
- prototyping

Tier 1 responsibilities

- manufacture of the part to specifications on blueprint
- JIT delivery to the auto company
- coating through outsourced coating provider

Auto company responsibilities

- core design and specifications
- testing capability for parts

4.2.2 Option 2 - No Presence, Service Level #1

In this option, the choice of geographical location is quite wide. The segment could be served by a domestic or European presence. We assume this because of the light requirements of level 1 service. They can potentially be achieved in a virtual fashion. Here is a general value chain

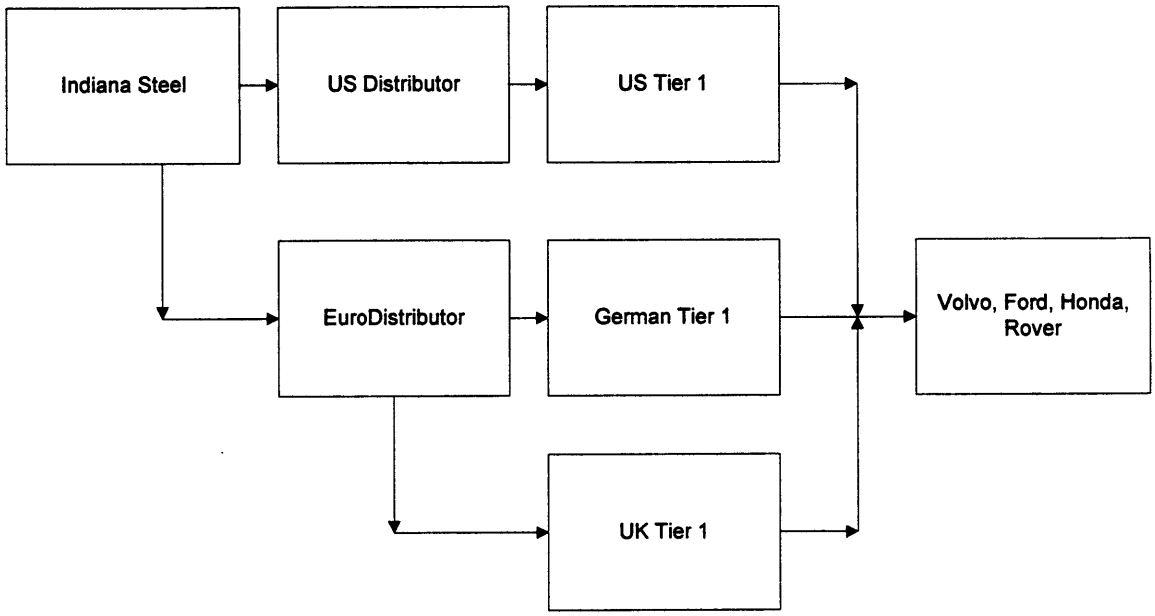

Figure 19 - General Value Chain for No Presence #1 Segment

Following this segment means that the Tier 1 will work through any means feasible or required by the auto company, as long as the Tier 2 exerts minimal (or level 1) service in the end. We can disaggregate the general chain into 3 separate parts, based on the location of the Tier 1 supplier.

US Located Tier 1

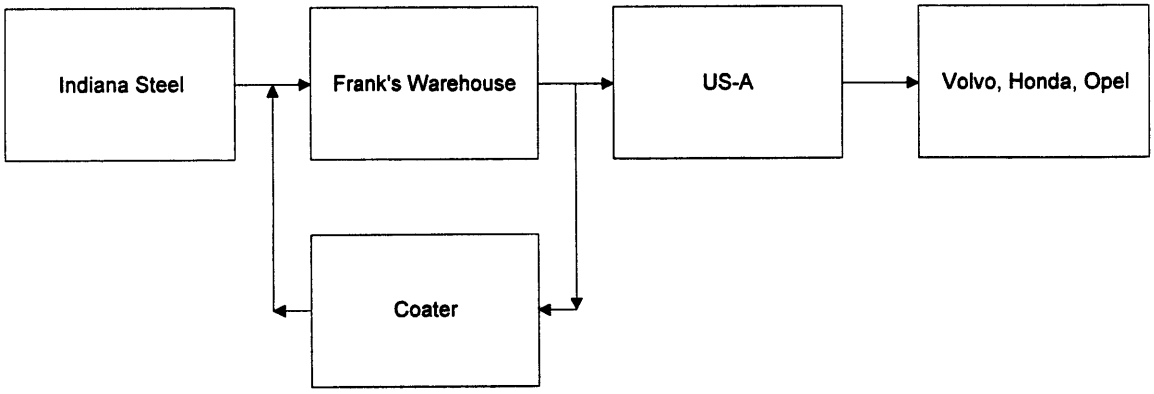

Figure 20 - US Value Chain for No Presence #1 Segment

Tier 2 responsibilities

- delivery to Tier 2 through standard operating procedure

- prototyping

Tier 1 responsibilities

- manufacture of the part to specifications on blueprint
- delivery to the auto company
- coating through outsourced coating provider

Auto company responsibilities

- core design and specifications
- testing capability for parts

UK Located Tier 1

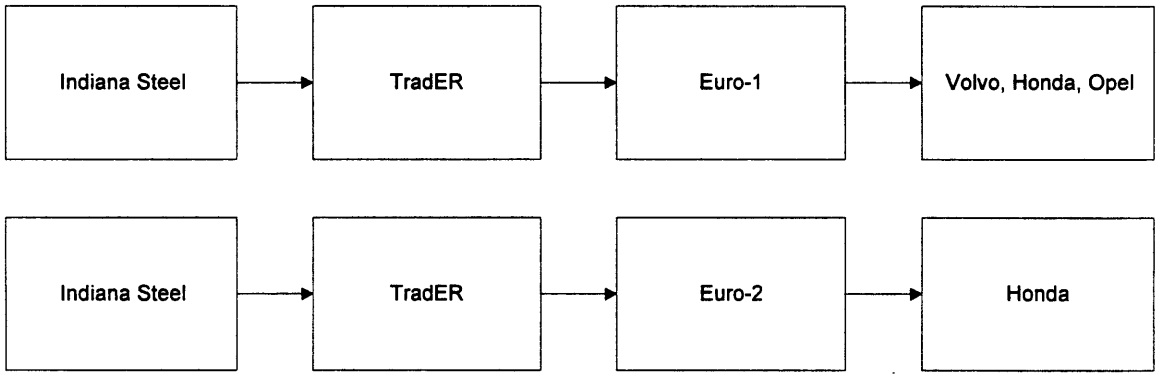

Figure 21 - UK Value Chains for No Presence #1 Segment

Tier 2 responsibilities

- delivery to UK using any means desired by auto company, as long as it is facilitated by Tier 1
- prototyping

Tier 1 responsibilities

- manufacture of the part to specifications on blueprint
- coating through outsourced coating provider

Auto company responsibilities

- core design and specifications

- testing capability for parts

Germany Located Tier 1

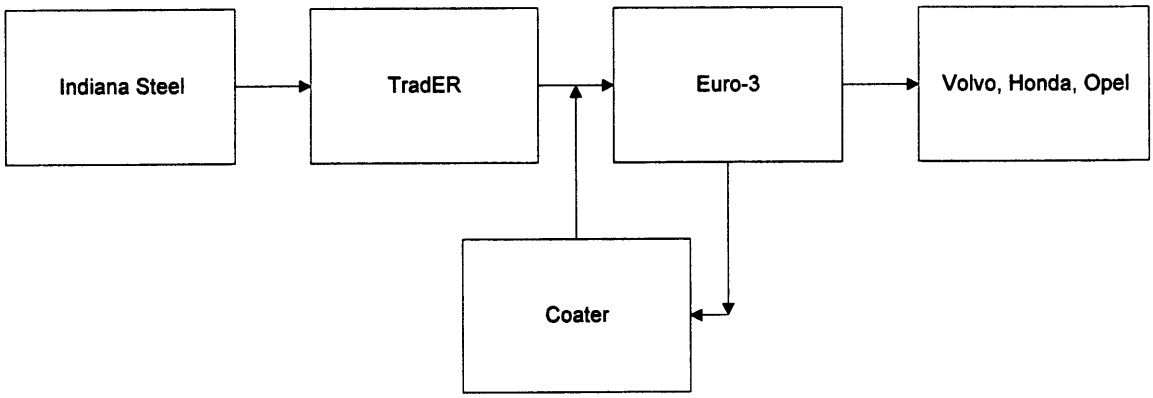

Figure 22 - German Value Chain for No Presence #1 Segment

Tier 2 responsibilities

- delivery to Germany using any means desired by Tier 2 (or auto company as long as it is facilitated by auto company)
- prototyping

Tier 1 responsibilities

- manufacture of the part to specifications on blueprint
- JIT delivery to the auto company
- coating through outsourced coating provider

Auto company responsibilities

- core design and specifications
- testing capability for parts

We can see that the distribution of responsibility is shifted more to the right the lesser service required by the auto company and the more familiar the Tier 1 and 2 players are with each other.

Table 14 presents a sampling of Tier 1 suppliers and their affiliations with different European auto companies. The most viable value chains involve a Tier 1 supplier with strong connections,

either previous or current experience, with the auto company. The Tier 2 can prepare for potential unsolicited business with an auto company by being cognizant of the ties that exist between different Tier 1 suppliers and auto companies.

Table 14 - Tier 1 suppliers and affiliations with different European auto companies

		Tier 1 Suppliers				
		US-A	US-B	Euro-1	Euro-2	Euro-3
	Rover			X		
	Ford	X		X		
European	Opel					
Auto	BMW					X
Companies	Audi					
	Volkswagen					
	Volvo					
	Honda		X		X	

The differentiating feature of the "No Presence#1" segment is that unlike the previously described segment, UK#2, or the Germany#2 segment (which will be discussed in section 4.2.4), where the ideal situation would be to have one value chain that serves all auto companies within the segment, the no presence #1 segment can have several value chains that fulfill the requirements of one or two auto companies within the segment. This is acceptable because theoretically the Tier 2 would encounter no additional hardship or pain from utilizing many service level 1 chains, versus, for example, one service level 2 or 3 value chain. Moreover, minimal marketing or sales efforts would be made by the Tier 1 or 2 supplier.

We will discuss the likelihood of this occurring in Section 4.3.

4.2.3 Option 3 - US Market Only

This segment, being the null set, has no value chain associated with it. This means that the Tier 2 supplier would have no presence in Europe at all, with respect to this particular product. Moreover, it means that any unsolicited business would be refused.

4.2.4 Option 2 - Location Germany, Service Level 2

In Option 2, location in Germany and level #2 service, would be a different value chain than any others previously discussed. The companies in this segment consist of Volvo, Opel, Ford, and Audi. One value chain option for this segment is as follows.

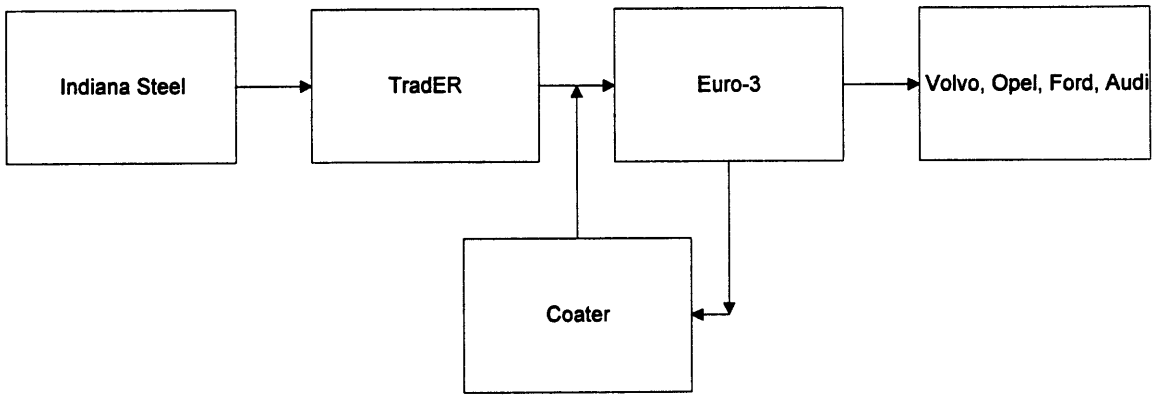

Figure 23 - Value Chain #1 for Germany #2 Segment

As in option #1, a level 2 service is required. The selection of the Tier 1 supplier with whom to partner is one that requires more investigation. There appears to be no shortage of roll formers in Germany who are willing to accept new business. However, there are currently no known roll formers who have roll formed an ultra high strength steel and few that are familiar with the bumper market. Moving a Tier 1 supplier up this dual learning curve (new technology and market) would be very challenging.

Tier 2 responsibilities

- delivery to German Tier 1
- design advice to auto company, either in person, or by teleconference and fax
- prototyping
- transfer of UHSS roll forming techniques to Tier 1

Tier 1 responsibilities

- JIT delivery to the auto company
- working with Tier 2's input to deliver design advice to the auto company
- coating through outsourced coating provider

Auto company responsibilities

- core design and specifications
- testing capability for parts

Marketing/sales would need to be coordinated between the Tier 1 and 2 suppliers.

Evaluation of Factors

Now we will address three more of the addendum issues described earlier - organizational stress, single sourcing, and political issues.

Organizational stress - serving the level 2 segment might necessitate some reorganization in the Tier 2 at home. Regardless, there would likely be one or two expatriates who would need to relocate to Europe. This would require some infrastructure be put in place, to facilitate communication between the Tier 2 and Tier 1, but much of this already exists and can be shared or rented out. As far as the level 1 no presence segment is concerned, lesser stress would be involved. The option with the least amount of stress involved is the third option, which also is the lowest potential return option.

Single sourcing factors - Whether we target one country or another country, it is likely that the choice of Tier 1 with whom to partner will be limited by their geographical location. This is not a problem with Option 2 because the Tier 1 choice would likely be different depending on which auto company is being considered. With the UK#2 or Germany#2 segments, this might be an issue because not all of the auto companies within these segments may have the desire to use the same Tier 1 supplier. This could potentially limit the size of each market even further. For example, in implementing a Germany #2 value chain, there are higher costs of labor and manufacturing associated with it, which would greatly deter the non German auto companies from participating. This will be discussed further in section 4.3.

Politics - Within the Tier 2 corporate strategy, there are certain auto companies that have been targeted as companies with whom the Tier 2 would like to grow. Basically, any US based company with international operations falls under this listing. A segment that includes these companies will receive favorable response from management at the Tier 2. In a similar sense,

because of the Tier 2's desire to develop key auto company relationships, there are strong proponents for doing some international business rather than none at all. This places Option 3 at a disadvantage to the other three options that include some form of international business. This is an assumption based on the current research of the Tier 2 corporate culture - further investigation may be necessary to comment more about the political ramifications.

4.3 Option Revision

With the value chains we have constructed in section 4.2, we can now begin the process of consolidating the chains into the most feasible options.

In the three segments that involve entering the European market in some form, there are three level 1 service auto companies that are common - Volvo, Honda, and Opel. Although it is technically possible to serve these markets from all three perspectives, Option 4 is a less attractive value chain to use for the following reasons:

- Labor and manufacturing costs are much higher in Germany than in the UK. It would be a greater cost to those non-German level 1 auto companies to use a German Tier 1 or distribution method.
- The Germany#2 segment received the lowest of the four scores in the optimization matrix

We will thus eliminate the Germany#2 option from further evaluation.

We can see if any of the value chains within each remaining segment are able to consolidated. Consider the UK#2 segment. If we look at the Tier 1 supplier affiliations table, we see that there are two UK Tier 1 suppliers, one of which has more auto affiliations than the other. Moreover, this Tier 1 has greater breadth of capability than the other UK Tier supplier, who is in actuality a division of a German based company. Partnering with the former Tier 1 gives two distinct advantages: 1) the benefits of existing relations with a greater number of auto companies, and 2) the possibility of completing any coating requirements at one location - eliminating the need for another player in the value chain. For targeting the UK#2 segment, a Tier 1 with coating

capability and more auto company relations leverages off more assets than other potential partners.

In considering the No Presence segment, we have previously mentioned that several value chains can potentially serve parts of this segment. This is because an auto company that requests the Tier 2 steel without having been influenced by marketing or sales would have picked their Tier 1 supplier and made arrangements with them to use the steel they have chosen. However, is this likely to occur? While there have been instances where the Tier 2 did have unsolicited requests for steel, in a market where there is little recognition of name brand, the segment might eventually merge with a different segment, or fade out entirely. It is unclear that the Tier 2 could win many customers without a concerted marketing effort.

In this section, we have looked at two more of the addendum factors to Kotler - learning curve effects and response time. We have discussed how the usage of a Tier 1 with coating capability reduces the number of players in the value chain. The UK#2 segment leverages off of existing customer relationships, which would in effect reduce response time and start the new business at a higher point on the learning curve. We can estimate that in approaching the European market, some aspects of the business are the same or similar to what is required of serving the current domestic market. In a segment that requires level 1 service, the value added can also be achieved using knowledge that was obtained from current domestic business. In this case, however, the requirements of the auto company are less stringent, which is why this option is feasible. The same value added to the European auto company can be achieved without the Tier 1 having to assume new tasks. What we want to do is remain on the same learning curve as long as possible before splitting into different paths. The learning curve would look somewhat similar to Figure 24.

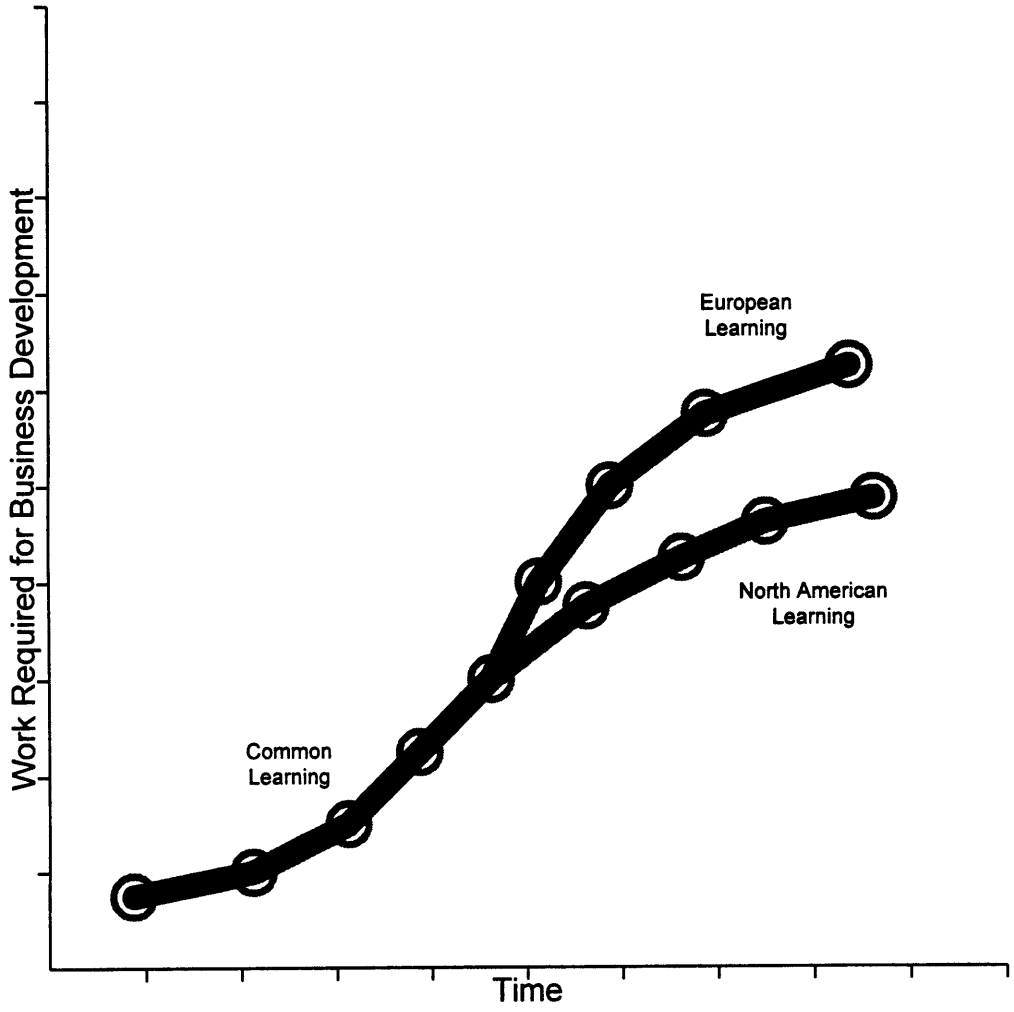

Figure 24 - Learning Curves for selling UHSS to Europe and North America

4.4 Formulate market strategy, price, and required services for each option

The price of alternative materials and processes will be the biggest driver for setting a price for UHSS in Europe. For this reason, this section will start off with a general discussion of pricing strategy without regard to which marketing strategy is pursued. Having established a price for the UHSS for the European market, the four business strategies identified in the previous section will be looked at in more depth in terms of the cost to service their markets.

4.4.1 Pricing Strategy

To be able to understand how to price the steel for the European market, we need to understand what alternatives our customers have. Since there is very little UHSS in the European market we move down stream one step and look at the cost of bumper reinforcement beams. To do this, we have developed a model on Excel that allows us to compute the price the automotive company will pay for a reinforcement beam depending on the UHSS price to the Tier 1 supplier. The model also computes the cost of a reinforcement beam made from competitive materials and different processes. This model is explained in Appendix A.

As a starting point, we assume that the steel will be sold at North American prices plus the cost of shipping and duties into Europe. With this as the baseline, a price comparison between roll formed UHSS and other materials is shown in Figure 25. These numbers will change depending on the volume requirements for the reinforcement beams. For this initial example, a volume of 100,000 vehicles is used. This number is representative of some of the higher volume vehicles in Europe that would be likely customers for UHSS. As previously discussed in Section 3.1.1.3, Regulations Pushing Weight Reductions, automotive manufacturers prefer lighter weight components. While their desire for weight reduction varies vehicle to vehicle, to come up with a better approximation of automotive manufacturers preferences, Figure 25 also indicates an adjusted price comparison, by adding a $ advantage for weight savings.

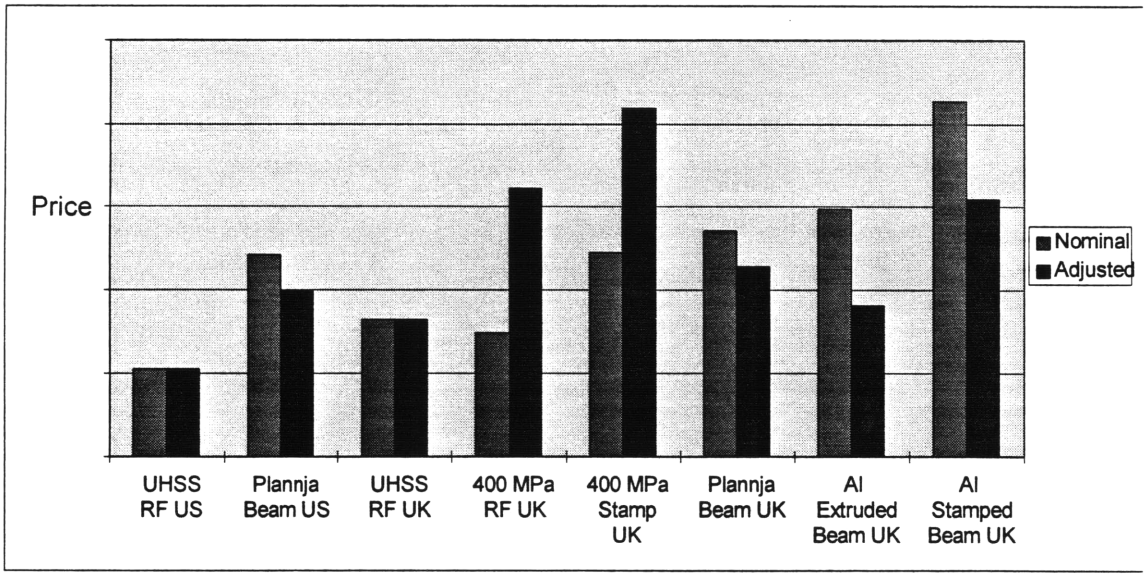

Figure 25 - Price Comparison Between Roll Formed UHSS and other materials

As seen in Figure 25, the UHSS solutions are approx. 15% lower in cost than the cheapest alternative. At this point, three questions need to be asked. First, how much of a cost savings is required to get the companies to accept UHSS. As previously explained, UHSS has a number of forming limitations making it more difficult to design shapes out of it. It is also an untested product in the European market with a limited supply base.

The second question that must be addressed is whether customers will tolerate a higher price for UHSS in Europe than it would cost them to buy it in the US and ship it overseas themselves. The higher price could potentially be justified to the customer because of the added costs of servicing a distant location. Of course, it is not obvious that the European customer would have access to or even try to learn what typical US prices are. The reverse could also be an issue if the UHSS was offered in Europe at better prices than in the US after adjusting for transportation.

The third question has to do with Indiana's competitors for UHSS. The only company offering UHSS in Europe today is Euro Steel. It is selling its high end product for significantly higher than Indiana is selling UHSS in the US (even after adding shipping costs). However, it has not been able to sell into the automotive bumper market at this price. There is also the potential for other competitors to try to enter this market some time in the future depending on volumes and prices that UHSS achieves in the marketplace.

Considering the three issues above it seems like the US price plus shipping and duties is a reasonable pricing choice. This will effectively mean lower margins for Indiana when selling to Europe, assuming a higher cost for servicing a more distant market. Whether this makes sense will be addressed in section 4.5 in the financial analysis.

4.4.2 UK#2

The idea of this option is to serve the UK market with level 2 service by having Indiana Steel employees stationed in the UK. These individuals would serve a combined role of marketing, sales, manufacturing support, and other services for all UK customers. Sales and marketing activities would start with customer education, prototype availability, and technical information about UHSS and the manufacturing process. A number of different people at the automotive company including purchasing, design, manufacturing, and management would receive varying

levels of education on the steel company and its products. Education of a number of individuals at the Tier 1 supplier would also be required. Once business was established, the UK field support individuals would serve as one stop shopping for any issues that the customer may encounter. UK field support would also be responsible for managing the relationships with other European customers outside of the UK, but only customers with more limited service requirements (level 1) would be pursued. Below is an estimate of the yearly cost to provide the above mentioned service:

Table 15 - Service Requirements for UK#2 Segment

Type of Support	Quantity	Rate	Cost
Field Support (UK)	2	$ 250,000	$ 500,000
R&D Support	0.5	$ 100,000	$ 50,000
Marketing / Strategic	0	$ 100,000	
Prototypes	100	$ 1,000	$ 100,000
International Travel	10	$ 5,000	$ 50,000
		Total Cost	**$ 700,000**

4.4.3 No Presence #1

This marketing strategy limits Indiana to pursuing customers who will not require a local presence (level 1 service). While this level of service does not include the steel company getting involved with manufacturing (the Tier 1 supplier's role), reality is not always that simple. Obviously, any manufacturing problem that is remotely thought to relate to material quality will tend to pull in the steel company. For this reason, the cost for this option might be more expensive if the Tier 1 supplier is in Europe. As a first approximation, however, we can estimate the cost of the no presence strategy as follows:

Table 16 - Service Requirements - No Presence #1 Segment

Type of Support	Quantity	Rate	Cost
Field Support (UK)	0	$ 250,000	
R&D Support	0.5	$ 100,000	$ 50,000
Marketing / Strategic	1	$ 100,000	$ 100,000
Prototypes	100	$ 1,000	$ 100,000
International Travel	10	$ 5,000	$ 50,000
		Total Cost	**$ 300,000**

4.4.4 US Market Only

The above estimates for cost of the UK #2 and No Presence strategy could end up being understated because of the scarcity of the resources used. For instance, the type of individual that can perform the UK field service role is limited. Such a person would likely be a useful resource in going after the quickly growing US market. In this way the true cost of the resource is the opportunity cost of not having the person work on the US market instead of the sum of his salary, benefits, and expenses.

4.5 Select Best Option Based on Financial Assessment and fit to Different Environmental Models

The purpose of this section is to evaluate the three options identified in section 4.3 from a broader perspective. This is done by ensuring that the nine environments are considered in the selection process. Much of this knowledge from the environments has already been incorporated into the market segmentation analysis. It will be further assessed through a financial model that looks at the profitability of the different options based on the anticipated pricing, volumes, and costs for each option. While much of the environments knowledge has been captured and used to reach the financial assessment, there are some qualitative issues that have not been included in the calculations. This section will first evaluate the financial performances for the three options, then take this data in combination with the softer issues to arrive at an appropriate business decision.

4.5.1 Financial Model

One of the biggest incentives for going into any new market is the potential for a positive return on the investment. To assess Indiana's ability to make money selling UHSS in Europe, a model was built on Microsoft Excel. Because of concern with the long term sustainability of European business on this product, a five year time horizon was used. In this five year horizon, the following assumptions have been made.

- The model assumes the company does not sell any volume in the first year as time would be needed to set up the supply system and win the business.
- In the second year, Indiana Steel would sell half of the volume predicted for the market segment
- In the remaining three years, the steel company would sell volume equal to the predicted volume.

The model accounts for manufacturing, distribution, inventory, tariff, processing, and service costs. It uses inputs of steel price and cost of capital to calculate a Net Present Value output along with individual revenues and profits for each year. The details of the model are explained in Appendix B.

4.5.1.1 UK level 2 Service

The financial model predicts that a NPV of almost $1.5M can be obtained by pursuing this option. The ROI for this investment is 39%. These results are shown in Figure 26. Sensitivity analysis was done for variation in volume of business since this is likely to be the biggest source of estimation error. The analysis shows that the break even volume is at 64% of the predicted volume. Overall, this project appears from the financial numbers to be an attractive investment.

Volume (Metric Tons)	Revenue 1997-2001	NPV with WACC = 13%			
1,000	$ 3,850,000	$ (2,072,919)			
2,500	$ 9,625,000	$ (1,256,485)			
5,000	$ 19,250,000	$ 104,238			
7,536	**$ 29,013,600**	**$ 1,484,555**			
10,000	$ 38,500,000	$ 2,825,683			
	Expected Market	**7536**			
	Break-even Volume	**4808**	64%		
	Expected NPV	**$ 1,484,555**			
	ROI	39%			
Assumptions:					
1. Provide Level 2 Service to UK customers, level 1 service to the rest of Europe					
2. Tier 1 supplier in the UK					
3. Station two people in the UK					

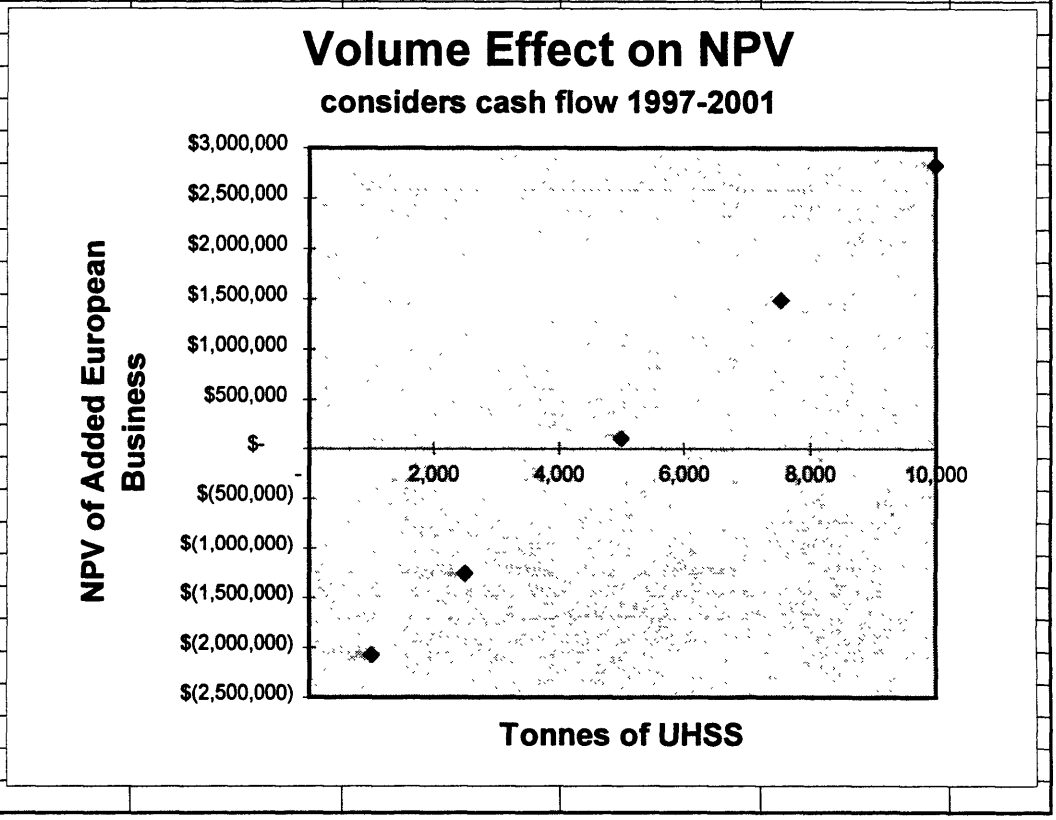

Figure 26 - UK Level 2 Service Finance Model Results

4.5.1.2 No Presence level 1 Service

Attempting to go after the European market without a local presence in Europe requires a smaller investment of resources and money. However, the financial model indicates the rewards are also significantly lesser (Results shown in Figure 27). The NPV is only $175K vs. the previously calculated $1.5M predicted for the more aggressive UK strategy. The ROI of 20% is significantly less than the previous ROI of 39%. A similar sensitivity analysis surrounding volume of steel reveals a break even point at 87% of the predicted sales level. From a financial stand point this project is reasonable, but not overly attractive.

Volume (Metric Tons)	Revenue 1997-2001	NPV with WACC = 13%			
1,000	$ 3,850,000	$ (604,060)			
1,500	$ 5,775,000	$ (345,260)			
2,000	$ 7,700,000	$ (86,460)			
2,505	**$ 9,644,250**	**$ 174,928**			
4,000	$ 15,400,000	$ 948,740			
	Expected Market	**2505**			
	Break-even Volume	**2167**	87%		
	Expected NPV	**$ 174,928**			
	ROI	20%			
Assumptions:					
1. Provide Level 2 Service to UK customers, level 1 service to the rest of Europe					
2. Tier 1 supplier in the UK					
3. Station two people in the UK					

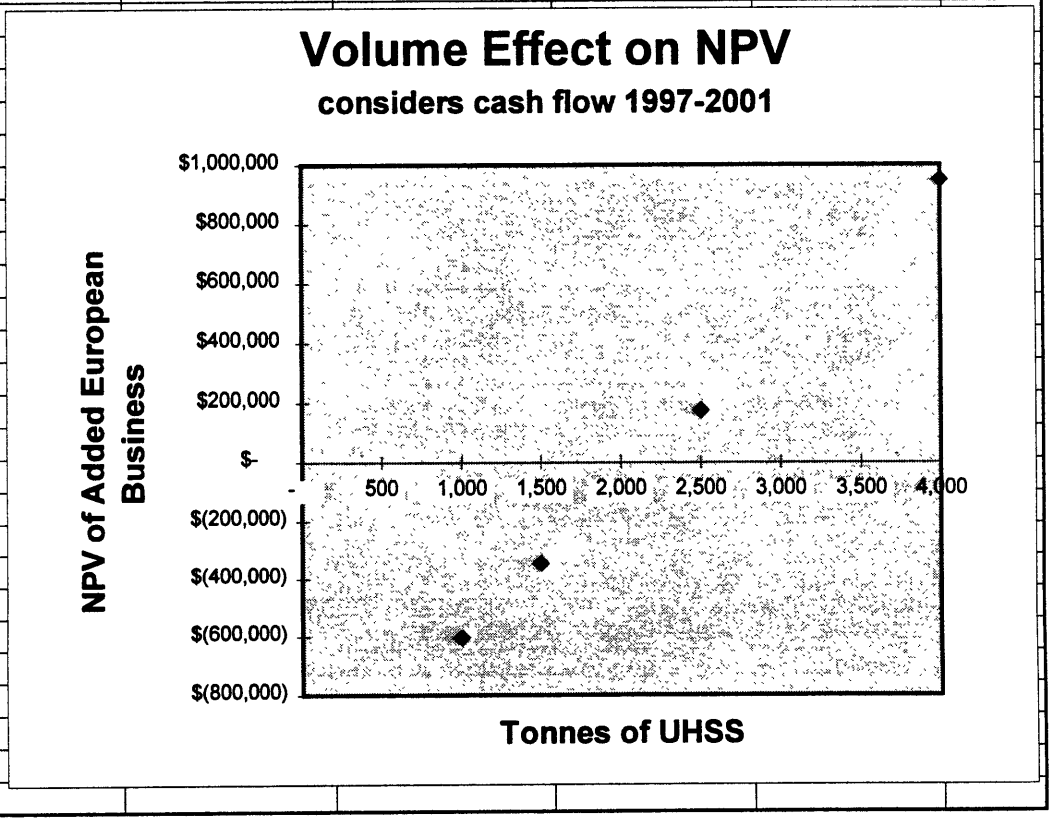

Figure 27 - No Presence Level 1 Service Financial Results

4.5.1.3 US Market Only

Because both of the previous two strategies would have to compete with resources devoted to the US market, it is useful to gauge the European opportunities against those opportunities in the domestic market. A rough estimate for the profitability of new business in the US can be obtained with the same financial model. International shipping costs are removed and service costs are calculated based on a certain portion of the existing staff being devoted to the new business (as opposed to sustaining the existing business). Results are shown in Figure 28 where a NPV of almost $12M is obtained.

Volume (Metric Tons)	Revenue 1997-2001	NPV with WACC = 13%
35,000	**$ 132,000,000**	**$ 11,999,161**
26,250	$ 99,000,000	$ 7,129,936
17,500	$ 66,000,000	$ 2,260,712
	Expected Market	**35,000**
	Expected NPV	**$ 11,999,161**

Assumptions:

1. US market grows 35,000 tons by 2001 (growth by year is 10K,10K,5K,5K,5K)

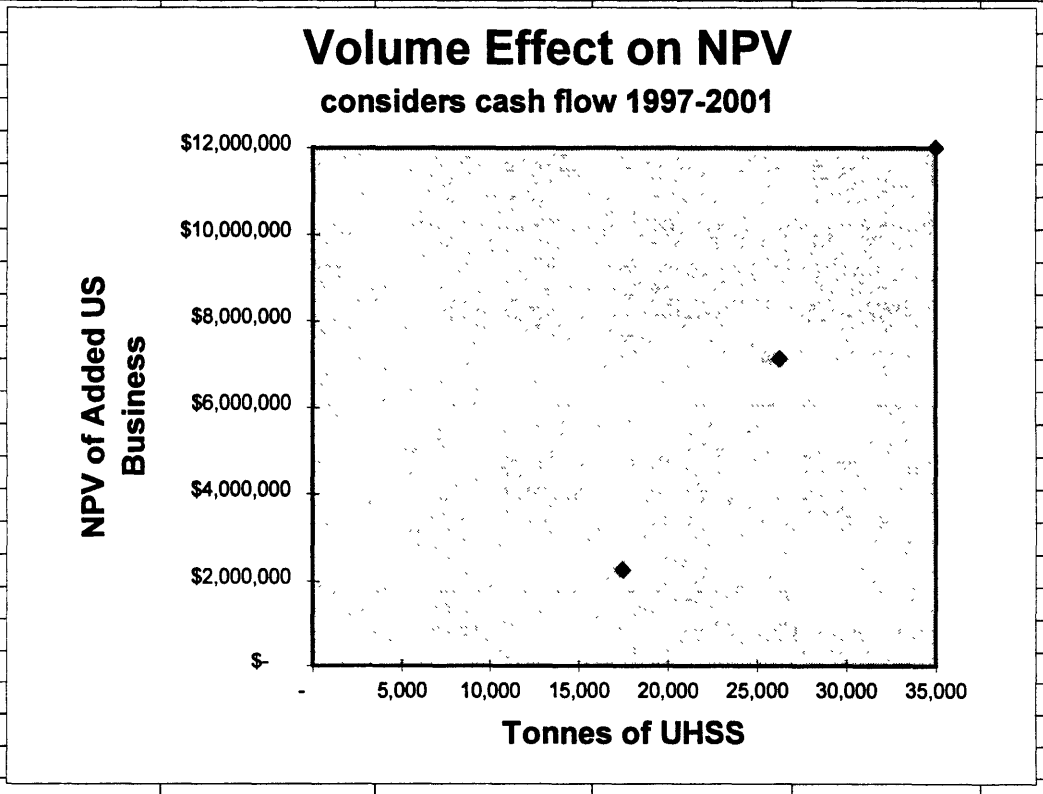

Figure 28 - US Business Only Financial Results

This is a significant opportunity cost were the Tier 2 to shift efforts from the US to European market. The impact on this much larger market must be considered in deciding how or if the European market should be pursued. The table below compares the financial data* from the three options.

Table 17 - Financial Data from Three Options

Option	Expected Market Size (metric tons)	Project NPV	Break even Volume	ROI
UK Level 2 Service	7536	$1,484,555	4808	39 %
No Presence level 1	2505	$174,928	2167	20 %
US Market Only	35,000	$11,999,161	NA	NA

*all financial numbers have been disguised to protect the confidentiality of Indiana Steel.

4.5.2 Non Financial Data

Having completed the financial analysis, each environment must be reviewed to see if that knowledge has already been incorporated into the financial results or needs to be used to revise any findings. Towards that end, the table below identifies for each environment how the data has been used or how it still needs to be applied to the final recommendation.

Table 18 - Assessment of 9 Environment Fit into Market Analysis

Environment	*How Incorporated Into Market Analysis*	*Remains to be Assessed ?*
Public Policy (Tier 1)	Significantly reduced size of available market	No
Consumer (Tier 1)	Covered in Market Segmentation Process	No
Competition (Tier 1)	Used to establish pricing for UHSS	No
Channel (Tier 1)	Financial Model will look at Inventory / warehousing costs to meet requirements	No
Tier 1 Assessment	Local Presence and Service Requirements	1. Does this business look attractive for Tier 1 player 2. How difficult is the learning curve for the Tier 1 player 3. Does the partnership add value to Indiana beyond the individual sales
Competition (Tier 2)	Used in establishing pricing for UHSS	No
Tier 2 Assessment		4. Effect on US Business through the use of scarce resources 5. Fit with Operational Excellence 6. Learning Valuable beyond initial project 7. Political Acceptance within the Organization
Public Policy (Tier 2)		NA
Channel (Tier 2)	Financial Model will incorporate shipping & distribution costs to meet European requirements	No

The above table reveals that the Tier 1 and Tier 2 environments have not been fully captured through the financial model alone. These two environments are therefore addressed below.

4.5.2.1 Tier 1 Environment (Roll former)

The Tier 1 Environment assessment would seem to push Indiana Steel towards implementing the UK level 2 service. At least two Tier 1 players in the UK seem well aligned with the steel

company's efforts to sell UHSS roll formed bumpers in Europe. From interviews with them, they seem to view roll forming UHSS as a business that can earn them good margins and would be something they could sell to their existing customers. They have experience roll forming complex shapes and the switch to roll forming UHSS from other roll formed steels would be relatively simple. Working with these European Tier 1 suppliers might be a good way for the steel company to learn about the European market and other opportunities that it might have outside of the UHSS business.

The strategy of no presence and level 1 service is probably not a fit for the Tier 1 environment to the extent that it would likely be done with a US Tier 1 supplier. While the US Tier 1 suppliers already are doing UHSS roll forming, none of them understand the European market. The learning curve to learn the new market is likely to be significantly more difficult for them than the European Tier 1 learning the technology. Also, the risk of supplying a European automotive customer would fall more heavily on the US Tier 1 player than the steel company in terms of customer expectations. The margins for roll formers in the US are not thought to be very high, and the costs associated with trying to go after European business would not fit well with most of their current situations.

4.5.2.2 Tier 2 Environment (steel company)

Within the steel company, the pursuit of European business would not fit well with the political and strategic direction of the company. The company is in the process of down sizing and focusing on operational excellence, both of which are pushing them to try to do their current operations more efficiently - not expand into new products or markets. Furthermore, without any increase in head count, they are aggressively planning to expand the sale of UHSS in the US. Individuals with key skills are in limited supply. Therefore it is hard to visualize how the US market would not be threatened by resources being directed to the European market.

Indiana Steel company does have a separate division that is focused on international expansion. They espouse the goal of being able to deliver to its global customers a global product. The resources in this group are limited however, and they can not act on this expansion without the support of the rest of the steel company. Following a strategy of limited effort that is driven by

the international group, as part of the no presence level 1 service strategy, is more tenable, but still not a perfect fit to the environment within the steel company.

4.5.3 Final Decision

Table 19 summarizes the strength of financial results and the two environments that are not directly tied into the model. By assessing this table we can make a more informed recommendation that considers all factors.

Table 19 - Summary of Financial Results and "Loose" Environments

	Financial Results	Tier 1 Assessment	Tier 2 Assessment
UK level 2 service	**Strong**	**Strong**	**Weak**
No presence level 1	**Moderate**	**Weak**	**Moderate**
US Market Only	**NA**	**NA**	**Strong**

Our recommendation, based on the above analysis, is for the Tier 2 company to concentrate on the US Market only. As a separate activity apart from the company, the UK level 2 service marketing strategy seems attractive. However, while the potential profits are attractive they do not appear attractive enough to warrant a marketing move that appears in conflict with the overall direction of the company. While the market is attractive, it is not very large in comparison to the overall business of the company or even UHSS business in comparison to opportunities to expand in the US.

If further studies, including those companies in Europe we did not have a chance to interview, show increased opportunities, the European business may at some point warrant a move into that market.

The no presence strategy could also be feasible if additional resources within the steel company were found. This is highly unlikely given recent announcements of downsizing and financial difficulty within the company. With the data collected to date, this analysis indicates that European UHSS business should not be pursued.

5. Conclusions

5.1 Specific Recommendation

5.1.1 What to Do Now

This paper has outlined and followed a strategy for investigating the UHSS European bumper market for Indiana Steel. Within the restricted context of this study, the recommendation was to forgo the European market and concentrate on US expansion. The real business environment is less restrictive, allows for discovery in areas outside of the defined scope, and does not require data collection to stop with the publishing of this paper. With this broader prospective, we have modified the recommendation for Indiana Steel as shown here:

1. Reinforce Indiana's ability to increase its share of new North American UHSS business
   - Aggressively go after opportunities in US market
   - Use competitive models to sell UHSS roll form beam solution to attractive segments
   - Use competitive models to look at appropriate pricing level for UHSS as new opportunities and competition come about
2. Obtain additional international market information
   - Arrange a trip to talk with the 50% of the European automotive market that has not been investigated.
   - understand European steel competitor strength range, prices, and capabilities
   - investigate other Tier 1 suppliers in Europe
   - determine safety regulations in other continents (for possible other international opportunities)
   - include other safety components outside of bumpers to the study
3. UHSS is a profitable product line and may require the company to follow different strategies with regard to UHSS then for its commodity products.
   - development of stampable lower tensile UHSS through supplier processing improvements or product chemistry
   - improve manufacturing control (tighten specification for yield and elongation)
   - continue to advertise the commitment to follow customers
   - monitor development of advanced Tier 1 processes that could be used in forming UHSS

4. Keep open communication with new European contacts
    - phone meetings and information exchange with interested companies
    - send material samples to companies doing unique testing where the data could increase the companies' understanding of advanced processing for UHSS
    - investigate business opportunities that have customer pull and that can be done with limited disruption to US business

The first recommendation is based on the following themes that were determined from the study.

1. Safety standards are much weaker in Europe than in North America. There is no legislation pending or in the pipeline which would call for a stronger bumper
2. Car styling makes packaging space very limited at the ends of the car, which is too small for roll formed bumpers with constant cross sections and sweeps to be made
3. Stamping is the predominant technology at auto companies that use steel reinforcing beams, and higher end companies typically use aluminum extruded parts
4. Volume projections for UHSS in North America show growth rates in tons larger than that of the new business opportunities that appear in Europe

In doing the study, we created the competitive pricing model (Appendix A) so we could understand how to price steel for the European market. In doing so, we found that we had generated a useful tool that could be used for the US market as well. In addition to using it to help set steel prices, it could also be used with automotive companies to sell a Tier 2 product based on post formed costs.

The second recommendation is merely based on the fact that during our internship we were limited in time and scope. Information is never complete, however, and a company will end up never making a decision if it waits for perfect information. Even with this in mind, however, it does not seem acceptable to us for Indiana to make a decision without covering the other 50% of the European automotive producers. The companies we did not visit mostly comprise a different market segment and have production in different European countries so extrapolation of their needs is difficult to do from the interviews we conducted. Also, based on the interest of the customers we did visit, we clearly saw opportunities outside of the bumper market that should

not be ignored. Lastly, it seems in Indiana's interest to more carefully look at the set of initial assumptions that we made in the decision to target Europe. From interviews in the US and in Europe, the automotive companies seem to be taking an increased interest in South America.

The third recommendation comes from observing a conflict between the overall corporate direction and what seems to make sense for a specialized profitable product. With commodity products, limited focus is required to keep cost down to maintain profitability. For specialized products, a lot more effort is justified in terms of the profit it can generate from increased sales. Understanding how to manage these higher end products within the overall corporate structure is a management challenge for Indiana Steel.

The fourth recommendation stems from the concept of emerging strategies. In the dynamic business environment most companies face today, it is impossible to simply follow a pre-selected course. As we met with automotive suppliers and manufacturers in Europe, opportunities presented themselves that we had not considered. With a reasonably small amount of effort required to keep up some of the newly formed relationships, Indiana Steel gains a window into many potentially profitable ventures.

5.1.2 Risks Associated with the Decision

The recommendation can be simplified into two components: (1) focus on the US market, but (2) continue to learn more about opportunities in Europe and possibly other markets. The risk associated with focusing on the US market is the lost opportunity of European business which is affected by the uncertainty of demand. Our expected market data was taken from interviews with handfuls of representatives from the auto companies. Many assumptions were made, as well as extrapolations of data points, leaving significant room for error. If the market is indeed bigger then our predictions, the opportunity costs could be sizable. This is somewhat mitigated by our continued probing of the market - we might discover our mistake.

However, because we are continuing to probe the market, we still have to worry about distraction of technical and managerial resources away from the US market. This problem is made worse if

Indiana Steel is going to accept piece meal projects driven by customer interest as they develop from these European contacts. Will some of the these projects seem like simple exporting contracts but end up requiring a much higher level of support? What are the legal liabilities associated with shipping a raw material that is going to be used as a automotive safety component? If problems arise because of issues with the supply chain will it end up reflecting badly on Indiana Steel or require them to invest money they had not planned on spending to fix the supply chain?

5.1.3 Looking at Future Business Opportunities

The analysis done during the six and a half month internship at the Tier 2 supplier was done in conjunction with a plan to expand their business into the European market. In the process of conducting interviews and working through the environments framework, other business opportunities have surfaced which are worthy of further investigation. Some of these opportunities have been hinted at in previous sections of the thesis. Here we will explain them in greater detail.

Other International Markets (specifically Latin America Expansion)

Many auto companies have recently made announcements regarding their expansion into Latin America. This is a potential area for Indiana to consider because of the closer proximity (lower distribution costs) to the US than other international markets. Also, because these areas are new to auto companies themselves, it might be strategic for Indiana to "get in on the ground floor" with these organizations.

Stamping of lower tensile strength UHSS

Interviews with several design engineers indicate a strong desire for a high tensile strength steel that can be formed using their existing stamping infrastructure. This is a potentially large market, but one that would require a large investment in R&D for developing an UHSS steel with higher elongation.

Alternative safety components

In the US there are other applications of UHSS besides bumpers. One of the goals of this internship was to delve into these markets, if time permitted. In particular the door beam and car seat markets are areas where UHSS have been used in the US and some interest seems to exist in Europe for these applications.

Specialized Products

In researching the European market, there are opportunities to market other Tier 2 product lines. There are other products beside ultra high strength steels which could be sold into the European market. For instance, dent resistant steels are a product in which auto companies are interested. As long as the product is a sufficiently profitable for the Tier 2 and not yet available in Europe, it is conceivable that it can be sold overseas as well.

5.2 Framework Advantages

In this paper two frameworks were developed and used in assessing the opportunity for Indiana Steel to sell UHSS in Europe. The first framework, the nine environments model, provided a useful way to organize the large quantity of data relevant to such a decision. There is a tendency to focus attention on certain types of data depending on the background of the analyst. Thinking about the data collection from these different perspectives mitigates this problem to some degree. The added complexity of growing a market from the Tier 2 position makes the need to keep a broad perspective even more important. With the data in the nine environments it also becomes very clear where knowledge is missing and where to focus the data collection process.

We created the strategy development framework to build off of the data collected in the nine environments model. Even after collecting information from different perspectives it is easy to go off towards a single solution without catching its pitfalls. The main purpose for the five steps in the strategy development framework is to add discipline to the analysis process and focus attention on the value chain. This value chain emphasis is crucial for the Tier 2 player attempting to drive the market.

5.3 Range of Applications for Framework

Our framework was used here to assess a steel company wishing to supply the automotive industry. However, this same model could be used in a variety of industries where a Tier 2 player might have reason to drive the OEM. For example, a supplier who has a new laser system might want to pitch it to a semiconductor company who could benefit from its incorporation into a photolithography tool set (Tier 1 supplier). The model is not necessarily limited in its usefulness only to Tier 2 players. A Tier 1 player or OEM responsible for supplier development might find this model appealing. Companies are increasingly outsourcing larger portions of their value chain out to other organizations. Managing these suppliers who effectively become strategic partners is an increasingly important function within large and small corporations alike. This framework, with some modifications, gives the company a better perspective to judge who is likely to make the best strategic partner. The framework is also scaleable, in that you could use it to look at single products or wide product categories.

5.4 Framework Limitations and Suggested Improvements

While the framework encourages a broad perspective, it does not give very specific feedback on how to collect the data. Throughout the market segmentation process an attempt is made to take the information in the nine environments and produce quantitative statements about the market. In a yet un-tapped market this is often a very inexact science. Further complicating matters is how to quantitatively rate the stress on the organization and similar factors against market volumes and profits. The final step of the strategy development framework does provide an avenue to take into consideration non quantifiable data. However, the process of generating questions in areas that have not been fully considered quantifiably, while very flexible, is somewhat unsatisfying in its rigor.

The framework also leaves a number of questions unanswered. How do you know when you have enough information? How aggressive should you be at converting environmental models into quantitative information? How do you handle missing information in your analysis if you do not have the luxury to continue to collect data?

It is probably more useful to use the nine environmental models in more dynamic method than we used on our internship. If a web page were set-up with links to the nine environments data

could dynamically be stored under these headings for a wide group of people. An ongoing attempt could be made to synthesize each environment into a coherent story which could be reviewed and commented on in real time by the team.

Likewise the analysis could be done dynamically as well. As different attractive markets became apparent, they could be defined, re-defined, sized up, and value chains concepts constructed to serve those markets. The analysis does not have to start only after all data is in. The process of starting the analysis early adds to the effectiveness of data collection as the purpose for certain types of information becomes more clear. To get the most use out of the analysis, it is best to share the process with a wide audience and this is increasingly easy as IT technology makes it easy for people in distant locations and on different schedules to interact.

ıdix A - Competitive pricing model assumptions

bed in Section 4.4.1, we have developed a model that calculates bumper reinforcement beam manufacturing costs to the auto com

ɛl is based on information obtained from interviews with European Tier 1 suppliers. The following is a list of assumptions on whi

ɒased.

Description

This model is a method for estimating the price a supplier would charge an auto company for a given part. It can be used for different part types, but it is currently set up for bumpers. Slight changes can be made for other parts (i.e. door beams). The model was based on information provided by Euro-2 about their open book accounting they provide their customers when they bid on parts. The base case model is a UK example, which is a simulation of the manufacturing costs of a bumper beam to be made in Q1 '97. Other manufacturing processes or material types can be simulated by changing the ***BOLD and ITALICIZED*** cells. Equations for different components may be changed is further information develops that would make the model more accurate.

1. Change ***BOLD and ITALICIZED*** fields to the process parameter values you are simulating
2. In the case where you have several scenarios you are modeling, you can change the volume manually, or you can link to the BUMPER RESULTS sheet and change volume for all scenarios by changing B17.
3. Cell B25 on each scenario sheet is the estimate of the cost / part the supplier is charging the auto company.
4. Model and base case is based on Euro-2 information and bumper dimensions as outlined below.
5. Other assumptions regarding different processes, capital costs, and equations such as manufacturing, finance, etc., are outlined below. These may be changed within the model when more accurate data is acquired.

Midsize Car Bumper Beam

Raw Material Prices

Product	**Price/kg (US)**	**Price/kg (Europe)**	**Source**
400 Mpa Steel	$ 0.61	$ 0.70	$.015 premium over cold roll (US) Euro-1 (Europe)
Dual Phase	$ 0.86	$ 1.29	Indiana (US), Model (Europe)
Martensite	$ 0.94	$ 1.38	Indiana (US), Model (Europe)
Plannja	$ 0.70	$ 0.79	Indiana (US), added $.09 to US (Europe)
Aluminum Ingot	$ 2.86	$ 2.86	Townsend Report
Aluminum Sheet	$ 3.74	$ 3.74	Frank's Warehouse

Prices are for deivered material in coil, sheet, or ingot form as appropriate
$.04 / kg added to slit and delivered steel coils in the US
European costs run with TradER shipping slitted coils

UK Unit Costs of roll forming for energy, labor rate, overhead rate, from Euro-2
Labor rate for stamping and plannja calculated for unionized labor

Beam assumptions				
Base Case -		*Offal (frame)*	*Rejects (%)*	
material - Dual Phase	roll forming	0%	8%	
length - 1397 mm	stamping	20%	8%	
width - 254 mm	extrusion	5%	5%	
total weight = 6.20 kg	plannja	20%	5%	
offal from holes in beam = 1%				
gauge = 1.87 mm				
Other Beam assumptions				
bracket weight = 1.04 kg				
Manufacturing Costs				
Floor Space (Roll forming)	Maintenance (roll forming) = 20% of utilized capital			
Floor Space (Stamping) = 2 X roll forming	Maintenance (stamping) = 5% of utilized capital			
Floor Space (Extrusion) = 1.5 X roll forming	Maintenance (extrusion) = 10% of utilized capital			
Floor Space (Plannja) = 2 X roll forming	Maintenance (plannja) = 10% of utilized capital			
Depreciation of capital = 10 yrs				
Depreciation of tooling - 5 yrs				
	Capital Costs	*Tooling Costs*		
Rollforming	$ 600,000	$ 300,000		
Stamping	$ 8,000,000	$ 2,000,000		
Extrusion	$ 500,000	$ 300,000		
Plannja	$ 6,000,000	$ 2,000,000		
Secondary Operations	$ 600,000	$ 200,000		

Equations

	A	B	C	D	E	F	G
1	Weight (including brackets)	B2+B3	Kg		Manufacturing Space	175	sqm
2	Est Material Weight (w/o brackets)	B8*B9*B10*B11*(1-B5)	Kg		Cost / sqm	$ 150	
3	Bracket Weight	1.04	kg		Capital Costs	$ 600	thousand
4	Material Strength	980	MPa		Tooling Costs	$ 300	thousand
5	Offal (Holes)	1%			Depreciation Capital	10	yrs
6	Offal (stamp frame)	0%			Depreciation Tooling	5	yrs
7	Total Offal	B6+B5			Volume of Cars	'Bumper Results'!B17	K/yr
8	*Gauge	SQRT(980/B4)*1.87	mm		Parts / Car	2	
9	Length	1397	mm		Maintenance	(F3*F18+F4)*0.2	thousand
10	Width	254	mm		Power Consumption	2	KW / part
11	Density	0.00000786	kg/mm3		Cost / KWatt	$ 0.06	
12					Fully burdened Labor	$ 19.25	/hr
13	Material Cost per kg (to Former)	$ 0.86	/kg		Manpower required	2	people
14	Mat Cost per 100 lb	B13/2.2*100	/100lb		Overhead rate	200%	
15	Rejects	8%			Allowed Profit	10%	
16					Parts / min	6	
17	* s1(t1)2=s2(t2)2				Utilization Efficiency	70%	
18					Effective Utilization	F7*F8*(1+B15)/(6*F16*60*F17)	
19					Value of Scrap	$ 0.11	per kg
20					WACC	8%	
21							
22							
23					Stamping Brackets & Welding		
24					- added manpower	2	
25	COST / PART	SUM(B26:B38)			- added mat cost	B3*0.61	
26	Raw Material Cost	B2*B13*(1+B7)*(1+B15)+F25			- added capital	$ 600	thousand
27	Materials Handling	B26*C27	7%		- added tooling	$ 200	thousand
28	Floor Space	(F1*F2)/(F7*F8*1000)			- parts / min	6	
29	Capital Cost Depreciation	(F3+F26*(F16/F28))/((F7*F8)*F5)			- added power	2	KW / part
30	Tooling Cost Depreciation	(F4+F27)/((F7*F8)*F6)					
31	Maintenance	F9/(F7*F8)					
32	Power	F11*(F10+F29)			E-coat (outsourced)		
33	Labor	F12*(F13+F24*(F16/F28))/(60*F16*F17)			- processing (per part)	$ 0.52	(per Townsend report)
34	Overhead	B33*F14					
35	Scrap/Offal Credit	-(((B7+1)*(1+B15))-1)*B2*F19					
36	E-coat (outsourced)	F33					
37	Finance	((F3+F26*(F16/F28))*F18+(F4+F27))*F20/(F7*F8)					
38	Profit	F15*SUM(B$26:B36)					

Appendix B - Financial Model

The financial model was designed to evaluate new business opportunities. The pages included are as follows:

1. Summary
- Inputs: product process as sold FOB Indiana Harbor
  WACC
- Output: slit and delivered price in Europe
  revenue, production costs, inventory costs, etc..., for each of five years
  NPV and cumulative revenue for 5 years

2. Customers
- input: metric tons of UHSS products sold each year
  shipping, processing, and distribution costs are linked from their appropriate pages

3. Shipping
4. Processing
5. Distribution
6. Production
7. Inventory Costs
8. Support Costs
9. EG Processing

Items 3 through 9 of this appendix contain information on multiple scenarios. Based on the scenario being investigated, the appropriate information from these pages is linked to Items 1 and 2. As it is shown here, pages 1 and 2 are configured for calculating the opportunities to be gained by concentrating on the US market.

Item 1 - Summary Sheet

NPV =	$ 11,999,161					
	Revenue	Prod. Cost	Inventory Cost	Support Cost	Coatings	Net Profit
1997	$ 11,000,000	$ 8,460,237	$ 254,658	$ 2,000,000	0	$ 285,106
1998	$ 22,000,000	$ 16,920,474	$ 509,315	$ 2,000,000	0	$ 2,570,211
1999	$ 27,500,000	$ 21,150,592	$ 636,644	$ 2,000,000	0	$ 3,712,764
2000	$ 33,000,000	$ 25,380,711	$ 636,644	$ 2,000,000	0	$ 4,982,646
2001	$ 38,500,000	$ 29,610,829	$ 636,644	$ 2,000,000	0	$ 6,252,527
Total	$ 132,000,000					
Assumption:			**Pricing:**	MC / 100lbs	Slit & Delivered	
WACC	***13%***		Product #1	***$ 50.00***	$ 51.80	
			Product #2	***$ 50.00***	$ 51.80	
			Product #3	***$ 50.00***	$ 51.80	
			Coated Product #4	***$ 60.00***	$ 61.80	
Note: WACC = Weighted Ave Cost of Capital						

Item 2 - Customers Sheet

	Volume (in Mtons)					
Material	1997	1998	1999	2000	2001	
Product #1	***10000***	***20000***	***25000***	***30000***	***35000***	
Product #2						
Product #3						
Coated Product #4						
Pricing	MC $ / 100lbs	MC $ / Mton	Average Shipping	Processing	Distribution	Slit & Delivered
Product #1	$ 50.00	$ 1,100.00	***$ -***	***$ 24.86***	***$ 14.83***	$ 1,139.69
Product #2	$ 50.00	$ 1,100.00	***$ -***	***$ 24.86***	***$ 14.83***	$ 1,139.69
Product #3	$ 50.00	$ 1,100.00	***$ -***	***$ 24.86***	***$ 14.83***	$ 1,139.69
Coated Product #4	$ 60.00	$ 1,320.00	***$ -***	***$ 24.86***	***$ 14.83***	$ 1,359.69

Item 3 - Shipping Costs

Carrier Type	Lot Size (Mtons)	Port of Departure	Port of Arrival	Shipping Cost		
1. Vessel (MC)	5000	Chicago	England	$ 185.46		
2. LASH Barge (MC)	390	Memphis	England	$ 229.14		
3. LASH Barge (SC)	390	Memphis	England	$ 232.16		
4. Container (MC)	18	Chicago	England	$ 328.79		
5. Container (SC)	18	Chicago	England	**$ 331.81**	*UK level 2*	
6. Container (bumpers)		Chicago	England	**$ 379.04**	*No Presence*	
7. Container (bumpers)		Chicago	Germany	$ 404.61		
	MC	MC	Slit & cut-to-length	MC	Slit and cut-to-length	
IMF Cost Structure	1-Vessel	2-LASH Barge	3-LASH Barge	4-Container	5-Container	
Volume of Shippment	***5000***	***390***	***390***	***18***	***18***	
Price of Steel ($/Mton)	$ 1,100.00	$ 1,100.00	$ 1,131.46	$ 1,100.00	$ 1,131.46	
TradER Commission	$ 55.00	$ 55.00	$ 56.57	$ 55.00	$ 56.57	***5%***
Banking and Insurance	***$ 1.00***	***$ 1.00***	***$ 1.00***	***$ 1.00***	***$ 1.00***	
Truck to metal wrapping	***$ 8.50***	***$ 8.50***	***$ 8.50***			
Metal wrapping	***$ 13.90***	***$ 17.90***	***$ 17.90***			
Railage to Memphis		***$ 19.84***	***$ 19.84***			
Container Costs				***$ 53.61***	***$ 53.61***	
Stevedoring US						
Freight DDU	***$ 45.00***	***$ 59.00***	***$ 59.00***	***$ 159.09***	***$ 159.09***	
Stevedoring at Destinaton	***$ 8.00***	***$ 12.00***	***$ 12.00***			
Steel Price Basis for Duty	$ 1,231.40	$ 1,273.24	$ 1,306.27	$ 1,368.70	$ 1,401.73	
Duty Charge	$ 41.87	$ 43.29	$ 44.41	$ 46.54	$ 47.66	***3.4%***
Insurance	$ 12.19	$ 12.61	$ 12.93	$ 13.55	$ 13.88	***0.9%***
Shipping Cost (England)	$ 185.46	$ 229.14	$ 232.16	$ 328.79	$ 331.81	
	England	Germany				
Price of bumper beam US	***$ 9.99***	***$ 9.99***				
# of Bumpers / Container	***2650***	***2650***				
TradER Commission	$ 76.85	$ 76.85	***5%***			
Container Loading	***$ 53.61***	***$ 53.61***				
Freight	***$ 159.09***	***$ 159.09***				
Duty Charge	$ 89.50	$ 115.07				
Cost / Mton	$ 379.04	$ 404.61				
Bumpers / Container calculated as follows: (appears weight constrained)						
Container						
39'6" X 7'8" X 8'9 1/2"			Weight	***6.5***	Kg	
Volume =	2675		W limit	18182	Kg	
bumper 4" X 5" X 56"			Efficiency	***95%***		
Volume =	***0.648***		Bumpers	2657		
Efficiency	***75%***					
Bumpers	3096					

Item 4 - Processing Costs

Processor	Location	Slit	Cut to Length	Average Inventory (days)	Cost (Mton)	
1. Frank's Warehouse	Indiana	3X	No	7	**$ 24.86**	*No Presence*
2. Frank's Warehouse	Indiana	3X	2X	7	**$ 31.46**	*UK level 2*
3. Processing In Europe	Europe	3X	2X	7	$ 50.00	
Note: Need to cut to length for UK Tier 1, but not for US Tier 1						

Item 5 - Distribution Costs

	UK, level 2	No Presence			
	Process in US Tier 1 in Europe	Process in US Tier 1 in US			
Transportation Cost	$ 26.55	$ 14.83			
Storage Cost	$ 9.89				
Total Distribution Cost	**$ 36.44**	**$ 14.83**			
Transport Distances (km)					
To Processor US	80	80			
Processor to Tier 1 in US		100			
Port in Europe to European Tier 1 Distributor	100				
Transport Costs					
To Processor US	$ 7.02	$ 7.02			
Processor to Tier 1 in US		$ 7.81			
Port in Europe to European Tier 1 Distributor	$ 19.53				
How Costs are Calculated					
Transport Cost Calculations	Pick / Drop flat fee/Mton	Travel - Rate ($/Mton-Km)	Distance	Cost	Cost Ratio against US
United States	*$ 3.85*	*$ 0.0396*	100	$ 7.81	
Europe	*$ 9.63*	*$ 0.0990*	100	$ 19.53	2.5
Storage Cost Calculations	1st Month	Rate add. months	Duration (days)	Cost	Mark-up
United States	***$ 6.33***	***$ 2.20***			
Europe (Central Warehouse)	$ 7.91	$ 2.75			***25%***
Europe (Customer Distributors)	$ 10.12	$ 3.52	28	$ 9.89	***60%***
Note: in US can store at processor for 30days without charge					

Item 6 - Production Costs

	($/Mton)	($/Mton)			Costs / year				
Material	Var Cost	Opportunity Cost	Prod Yield	Slit Yield	1997	1998	1999	2000	2001
Product #1	$ 500	$ 250	75%	98.5%	$8,460,237	$16,920,474	$21,150,592	$25,380,711	$29,610,829
Product #2	$ 500	$ 250	80%	98.5%	$ -	$ -	$ -	$ -	$ -
Product #3	$ 500	$ 250	85%	98.5%	$ -	$ -	$ -	$ -	$ -
Coated Product #4	$ 500	$ 250	90%	98.5%	$ -	$ -	$ -	$ -	$ -
				Tot Cost	$8,460,237	$16,920,474	$21,150,592	$25,380,711	$29,610,829
Note: Var Cost is the marginal cost of producing the steel									
Opportunity Cost is the Loss contribution from the product UHSS replaces									

Item 7 - Inventory Costs

UK, level 2						
Year	1997	1998	1999	2000	2001	
Days of Inventory	65	65	65	65	65	
Value of Inventory	$ 1,958,904	$3,917,808	$4,897,260	$5,876,712	$6,856,164	
Carying Cost	$ 254,658	$ 509,315	$ 636,644	$ 763,973	$ 891,301	
No Presence						
Year	1997	1998	1999	2000	2001	
Days of Inventory	93.6	93.6	93.6	93.6	93.6	
Value of Inventory	$ -	$5,641,644	$7,052,055	$8,462,466	$9,872,877	
Carying Cost	$ -	$ 733,414	$ 916,767	$1,100,121	$1,283,474	
Required steps following P.O.	Master Coil by Vessel	Master Coil Lash Barge	Slit Coil Lash Barge	Master Coil Container	Slit Coil Container	Bumper Container
Stockpile Orders						
Production Cycle Time	28	28	28	28	28	28
Storage at TradER	70	28	28	7	7	7
EG coating M.C.cycle time+ transport						
Processing			7		7	7
Forming						7
Accumulation (not @ TradER)						
Prep for Overseas shipping	24	14	14	1	1	1
Wait for Ship Availability	7	1	1	1	1	1
Overseas Transport	20	20	20	20	20	20
Processing	14	7		7		
Ship to Distributor	1	1	1	1	1	1
Customers Distributor	84	42	42	28	28	28
Total Cycle Time	248	141	141	93	93	100
Days of Inventory (starting after production)	220	113	113	65	65	72
* Multiplicity Factor	1	1	1	1	1	1.3
Product (Days X Multiplicity)	220	113	113	65	65	93.6
* Multiplicity Factor allows inventory value figured on steel selling price to be increased or decreased						

Item 8 - Support Costs

UK #2			
Type of Support	**Quantity**	**Rate**	**Cost**
Field Support (UK)	***2***	***$ 250,000***	$ 500,000
R&D Support	***0.5***	***$ 100,000***	$ 50,000
Marketing/Strategic	***0***	***$ 100,000***	$ -
Prototypes*	***100***	***$ 1,000***	$ 100,000
International Travel	***10***	***$ 5,000***	$ 50,000
		Total	$ 700,000
* includes shipping cost			
Also Need			
1. Inventory of typical solutions (prototypes) in Europe for Field Support to show / give to customers			
2. Need quick turn-around of specific customer prototype requests			
3. Clearly defined, technical manual, of UHSS formability and weldability			
4. Performance / Quality data on the UHSS (nominal performance and level of variation)			
5. Clear Strategy worked out with Roll Formers about actions to obtain new customers			
6. Build a data base on roll forming equipment requirements based on part design			
No Presence			
Type of Support	**Quantity**	**Rate**	**Cost**
Field Support (Europe)*	0	$ 250,000	$ -
R&D Support	0.5	$ 100,000	$ 50,000
Marketing/Strategic	1	$ 100,000	$ 100,000
Prototypes**	100	$ 1,000	$ 100,000
Travel	10	$ 5,000	$ 50,000
		Total	$ 300,000
* Assuming that US partner will also send someone overseas			
** includes shipping cost			

Item 9 - EG Processing

	$ / ton	$ / Mton
Transportation to Canada (Metal Coatings)	***$ 31.00***	$ 34.10
Metal Coatings bill to Inland	***$ 250.00***	$ 275.00
Transportation from Canada to Inland (for storage prior to overseas shipment)	***$ 31.00***	$ 34.10
Electro Galvanizing Total Cost		$ 343.20

Appendix C - Galvanic Series of Metals and Alloys

taken from *What Every Engineer Should Know About Corrosion*, Philip A. Schweitzer

Anodic (Corroded) End

Magnesium
Magnesium alloys
Zinc
Beryllium
Aluminum 5052, 3004, 3003, 1100, 6053
Cadmium
Aluminum 2117, 2017, 2024
Mild Steel (1018), Wrought Iron
Low alloy high strength steel, Cast iron
Chrome iron (active)
430 Stainless (active)
302, 303, 321, 347, 410, 416 Stainless (active)
Ni-resist
316, 317 Stainless (active)
Carpenter 20Cb3 Stainless (active)
Aluminum bronze (CA687)
Hastelloy C (active), Inoconel 625 (active), Titanium (active)
Lead/tin solder
Lead
Tin
Inconel 600 (active)
Nickel (active)
60 Ni-15 Cr (active)
80 Ni-20 Cr (active)
Hastelloy B (active)
Naval brass (CA 465), Yellow brass (CA 268)
Red brass (CA230), Admiralty brass (CA 443)
Copper (CA 102)
Manganese bronze (CA 675), Tin bronze (CA 903,905)
410, 416 Stainless (passive), Phosphor bronze (CA 521, 524)
Silicon bronze (CA 651,655)
Nickel silver
Cupro-nickel
430 Stainless (passive)
Nickel Aluminum bronze
Monel 400, K500
Silver solder
Nickel (passive)
60 Ni 15 Cr (passive)
Inconel 600 (passive)
80 Ni 20 Cr (passive)
Chrome iron (passive)

Silver
Titanium (passive)
Graphite
Zirconium
Gold
Platinum

Cathodic (Protected) End

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