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Nikita GEORGANAS

AUTEUR DE LA THÈSE - AUTHOR OF THESIS

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C. Navarre

DIRECTEUR DE LA THÈSE - THESIS SUPERVISOR

E. Petriu

CO-DIRECTEUR DE LA THÈSE - THESIS CO-SUPERVISOR

EXAMINATEURS DE LA THÈSE - THESIS EXAMINERS

V. Groza

F. Julien

J.-M. De Koninck, Ph.D

LE DOYEN DE LA FACULTÉ DES ÉTUDES SUPÉRIEURES ET POSTDOCTORALES

DEAN OF THE FACULTY OF GRADUATE AND POSTDOCTORAL STUDIES

# Car supplier and manufacturer connectivity issues

by

Nikita Georganas, BSc., B.Ed.

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# Abstract

In today's fast pace society, analysts are expected to make quick educated decisions out of very complex situations. This is not an easy task to achieve but, if equipped with the proper decision tools, it can be effectively accomplished. Cognitive Maps have been commonly used in the past for this purpose but they lack a certain precision. Recently the use of Fuzzy Cognitive Maps (FCMs) has been proposed as an alternative for representing and analyzing complex systems that create outcomes that are not always easily definable. This thesis will introduce its readers to this versatile decision analysis tool and its many uses in a diversity of fields. More precisely, it will help analyze and determine how Internet transforms relationships between car parts suppliers and automobile manufacturers.

With the help of the Car Internet Research Program (CIRP), 17 semi-structured interviews of executive heads belonging to upstream suppliers in the automotive sector were considered as means of this research. Summarized and analysed through the help of FCMs, these exchanges give an approximate picture of the state of current events in the automotive industry, more precisely in regards to supplier and manufacturer connectivity issues.

# Acknowledgements

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Nikita Georganas

Ottawa, December 2003

# List of Acronyms

| | |
|---|---|
| AI | Artificial Intelligence |
| ANN | Artificial Neural Networks |
| ANX | Automotive Network Exchange |
| B2B | Business to Business |
| CAD | Computer Aided Design |
| CIRP | Car Internet Research Program |
| DARPA | Defence Advance Research Projects Agency |
| DSS | Decision Support Systems |
| EDI | Electronic Data Interface |
| EDS | Electronic Data System |
| FCM | Fuzzy Cognitive Map |
| W3 | World Wide Web |
| OEM | Original Equipment Manufacturer |

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# Chapter 1

# Introduction

## 1.1 General

The primary objective of this thesis is to investigate the potential use of Fuzzy Cognitive Maps (FCMs) applied to specific relationships in the automotive industry. More precisely, the thesis addresses how Internet affects relationships between car parts suppliers and automobile manufacturers.

## 1.2 The new era of connectivity

The first sign of wired long distance communication dates back to 1840 with the invention of the telegraph. It consisted of signals sent over wires that were established over vast distances. The U.S. used it extensively during the American Civil War and developed the Morse code, which consisted of short and long signals sent over it. The telephone and radio soon followed the same technological communication revolution. But nothing has come as close to revolutionizing the means by which information is being dissipated as the Internet has. Soon after computers where invented and commonly utilized, Internet was born. Many great inventions stem from the strong influence of a country's national security requirements and mandate to "prevent external threats at all cost". The Internet is not exception to this. The Defense Advanced Research Projects

Agency (DARPA) created it in 1968 [Leiner 2000]. It was then called ARPANET and initially consisted of a small network of computers communicating with each other using low speed telephone lines. ARPANET grew fast and joined other national networks to create Internet, a network of networks. The Internet is the father of all networks. It is a very flexible tool providing its users with a wide range of services. For instance, it can be the mechanism for information dissemination, and a medium for collaborative interactions between many individuals and their computers residing in different parts of the globe. Many governments, universities and private computer users are connected to this vast network permitting virtual communications that were once never thought possible. Through this marvel appeared another one, the World Wide Web (W3). Now that the Internet existed, digital information could be accessed from anywhere around the world, as long as computers were networked. Unfortunately this was no easy task, because no user-friendly software had yet been invented to easily search and retrieve information. One had to know on which computer the information was located and the address (IP address) to get to it. Sometime in 1989, Tim Berners-Lee, a nuclear research employee working at the CERN institute in Geneva, remedied this predicament. He invented a very simple and efficient interface permitting to easily access information that was scattered among the various computers connected to the Internet. He named his invention the World Wide Web. As of September 2002, approximately 605 million people are connected to the WWW [Nua 2002]. This new tool has helped thousands of people and companies save millions of dollars in costs. Take shopping online for example; it eliminates the need for a salesperson and a real physical purchasing location, enabling the buyer to purchase products at significantly lower prices than would be found

in stores. One can shop for almost anything, ranging from a pair of shoes to specialty car parts, straight from Germany or other countries. Although this may be beneficial to the consumer, it greatly handicaps the retailers. Unless they can quickly adapt to the significant changes brought upon them, they risk future extinction. The Internet and the World Wide Web are the paths that are paving the future. Ignoring their influence and impact on all aspects of ones everyday life would be like denying ones will to survive.

## 1.3 The automotive industry

The automotive industry is composed of many players that have different relationships with one another. For the purpose of this study, we will limit ourselves to a brief overview of automobile manufactures and suppliers. Manufacturers such as GM, Ford and Honda create and assemble vehicles. Car suppliers are companies that create and produce car parts for the manufacturers. Denso and Magna are two examples of world class car suppliers. Denso is the current leader of air-conditioning units and one of the few suppliers that has the power to decide what they will build for whom. In general most major car manufacturers exert a huge amount of power and influence over their suppliers. Because carmakers are such big players in this business, they control the market. This can create a very hostile atmosphere between manufacturers and suppliers. In fact, at the beginning of the 21$^{st}$ century, car builders imposed a big price drop onto their suppliers, which created a breach of faith and confidence between the suppliers and their clients (manufactures).

Most suppliers are now struggling for survival and have no choice but to obey their "master's" wishes. When things finally seemed to stabilize, reverse auctions appeared

and continued the inevitable landslide. Reverse auctions are manufacturer based online auctions that force suppliers to compete against each other, given a price point to match. A manufacturer will, for example, ask to have an air conditioning unit built for 25$ when it would normally cost 35$. Whichever supplier is the first to offer its services at that price, wins the auction. This new system eliminates all close bonds that once existed between a supplier and his trusted client(s). The car industry therefore becomes a meat market, where all players who have the right cuts get to sell and all others perish away through time. With this ongoing revolution only the strongest will survive. It is therefore critical for suppliers to find an edge over their competitors in order to assure their continued existence.

## 1.4 Decision Support Systems (DSS)

In the automotive industry like in many other fields a multitude of decisions are taken on daily basis (operational, tactical, strategic, etc). However some decisions are much harder to make than others and demand far more attention and time to analyze and assess. These decisions require the help of decision support systems (DSS) to accelerate the process and help eliminate possible unforeseen future events. The DSS have come in many shapes and forms, but as we entered the 21$^{st}$ century they took on the shape of software products aimed at improving the quality of decision making [Power 1997]. The primary task of a DSS is decision analysis. Most real-life problems are amorphous in nature. These circumstances make it difficult to apply quantitative measures based on mathematical models to the process of decision analysis. A variety of analytical tools such as influence diagrams and decision trees can be helpful in qualitative circumstances

but still require considerable experience with decision analysis and programming [Howard 1984]. Because of these factors, such DSS are no longer commonly used. Instead, a new breed of systems, called Intelligent DSS, have been developed. These systems use a combination of artificial intelligence (AI) and DSS. Other alternatives that have also commonly been used include expert systems, artificial neural networks (ANN), fuzzy logic and hybrid approaches.

## 1.5 Intelligent Decision support systems

Substantial work has been done in management science to use causal models in order to overcome the complexity of underlying strategic planning issues in DSS. Several approaches try to reduce this complexity by modeling the underlying cause-and-effect relations between certain business elements.

A well known strategic planning methodology is the Balanced Scorecard, introduced by [Kaplan 1992]: In order to formulate a homogenous business strategy, they propose to harmonize individual goals by linking them together within cause-and-effect-diagrams. The logic behind this technique is based on their findings that key business measures can most efficiently be influenced via so-called lagging indicators or business drivers [Kaplan 1996], which are mostly of non-financial nature. According to [Kaplan 1992], managers should formulate strategic goals which are equally distributed over all of the perspectives –financial, as well as process-, customer- or innovation-specific. The cause-and-effect relations – linking these measures together– allow the identification of competing goals:

"By forcing senior managers to consider all the important operational measures together, the balanced scorecard lets them see whether improvement in one area may have been achieved at the expense of another" [Kaplan 1992].

Another approach is derived from the work of [Vester] [Vester 2001] in the area of biocybernetic complexity management: His **Sensitivity Model** depicts a cybernetic system with dynamic influence relations between interacting elements. This basic concept is summarized as follows: "One of the main reasons for the crisis of our industrial society lies in the lack of awareness of the closely interwoven factors, which are involved in the process of our civilization".

These two approaches, provide powerful tools to tackle the complexity, which is characteristic for strategic planning as an optimization technique applied to a management DSS system. However, they have one crucial shortcoming in common, since they are based on the assumption that the cause-and-effect relations are given. As a consequence they do not describe a way to ascertain objective influence measures: "Over the short term, managers' assessment of strategic impact may have to rest on subjective and qualitative judgments. Eventually, however, as more evidence accumulates, organizations may be able to provide more objectively grounded estimates of cause-and-effect relationships" [Kaplan 1996].

By using a combination of artificial intelligence techniques with DSS there have been some improvements done to the performance of the above more traditional systems. The **expert system** is the most common of AI techniques used in DSS. This system attempts

to extract and codify human expertise using a computer program which then draws its own detailed conclusions [Jackson 1998]. The literature is rich in applications of expert systems to DSS in various fields [Sol 1985] [Doyle, 1993].

**Artificial Neural Networks** (ANN) can be used as another alternative modeling technique for use in DSS. ANNs are systems that have been inspired by the behavioral patterns of neural synapses in a mammalian brain. They distinguish themselves from experts systems because of their ability to learn from example sets. Once they familiarize themselves with specific model sets, they learn from them and use them to correct previously unseen inputs. Artificial Neural Networks have the favorable feature to deal with "noisy input" (resulting from the (unknown) influence of exogenous indicators (i.e. variables not included in the model)) by massively parallel operations carried out by neurons and consequently seem to be a proven tool for the verification of cause-and-effect assumptions.

[Hillbrand 2002] describe a ANN-based approach to model and analyze the complex causal relations, which need to be analyzed for strategic planning issues. Some managerial theories, as the Balanced Scorecard approach [Kaplan 1992] and the Sensitivity Model [Vester], assume that there is a negative association between the activity of an indicator (i.e. its impact on the overall system) and its ability to be measured by numeric means. Since many Decision Support Systems based on causal concepts only assume hypothetical belief structures as a foundation for building strategies, this approach infers unknown causal relations from empirical observations: Transforming a single-stage influence relation into a multi layer ANN, with training

patterns derived from operational databases, they show that it is possible to automatically ascertain the correlation of influencing and influenced indicators by the means of the smallest Remaining Error.

During one's everyday life, one is often perplexed by having to make decisions using facts and evidence that have varying degrees of truth and falsehood. Such events have to be factored into account when designing decision support systems. **Fuzzy logic** serves exactly this purpose. It is a form of inexact reasoning (fuzzy in nature) that permits us to extrapolate results from imprecise circumstances or events [McNeill 1993]. It allows common human language statements and interactions to be interpreted mathematically.

As previously mentioned, rule-based DSS suffer from some drawbacks, even the ones incorporating fuzzy rules. Since not all knowledge can be captured in the form of production rules, expert systems are inadequate in many situations. But their Achilles tendon is really their inability to adapt and evolve in environments involving feedback. Unfortunately, most of today's real world issues happen in ever-changing environments that do contain feedback loops. What would therefore be needed is a versatile DSS tool capable of modeling environments, which evolve dynamically through various stimuli.

**Fuzzy Cognitive Maps (FCM)** is a promising new tool capable of filling in such criteria. FCMs originated from cognitive maps, which will be discussed next.

## 1.6 Cognitive maps

Trowbridge created the first cognitive map in 1913, while investigating human behavior related to certain orientation tasks [Hafner 1999]. We call them "cognitive maps" because they represent cause and effect relationships. There exist many various definitions of

cognitive maps, however we have chosen the following: "*A cognitive map is a neural mechanism which enables its user to solve navigation and orientation tasks as if using a real map of the environment*" [Mallot 1995]. Cognitive maps help simplify (code) a human's complex interactions with his environment. They constitute a mental representation of one's environmental knowledge base. In this study, we will limit ourselves to the graphical representation of cognitive maps. Expressed graphically, they are a collection of nodes linked together by arcs or edges. Nodes are a graphical representation of concepts in interaction. Edges define the type and severity of causal links between these concepts [Chaib 1998]. The edges posses two important attributes: First, they are directed to show the direction of influence and second, they are signed (+/-) . When signed + they represent promoting effects and when signed – they represent inhibitory effects. Let us look at figure 1.1 for a better understanding of what has just been worded.

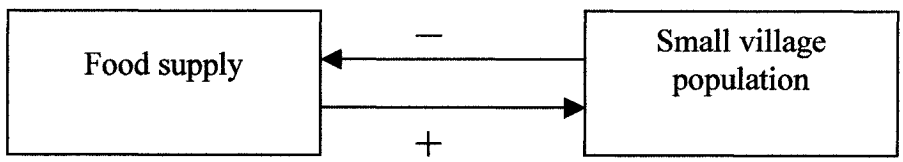



**Figure 1.1 Cognitive map of a simple ecosystem**

For argument's sake lets image a simple ecosystem where only humans (small villages) and their surrounding food supply exist. The villagers survive off the food supply; therefore, if the food is abundant they will thrive. On the opposite side, if the village population grows, the food supply will diminish.

The cognitive map of figure 1.1 represents exactly this relationship. The two factors of the system are represented by the two-labeled rectangles called nodes. The edges (arrows) going from one factor to the other indicate who influences whom (causality), and their signs designate what the type (effect) of influence they project. In other words the arrows tell us that the amount of food supply has an affect on the villagers, and that the villagers have an effect on the food supply.

The (+) arrow, going from the food supply to the villagers, indicates that an increase in the food supply will cause increase in the village population. We can also correctly hypothesize that if the food supply where decreasing, so would the village population. This relationship represents a positive correlation because both factors are affected the same way (Big-Big , Small-Small).

The (-) arrow going from the Villagers to the food supply indicates that a decrease in the village population will create an increase in the food supply, and that a raise in the number of villagers would reduce the amount of available food. In this situation we are dealing with a negative correlation because both factors react in opposition (Small-Big, Big-Small). In a cognitive map, all correlations between two nodes are added up to determine a final state. Unfortunately, if the results are a mix of positive and negative influences, the map is said to have an imbalance and the net effect of one node on the other is indeterminate.

From a more formal soft computing perspective, Bart Kosko has pioneered the use of the Fuzzy Cognitive Map (FCM) concept [Kosko 1986], [Kosko 1992] and [Kosko 1997]. The FCMs are fuzzy signed directed graph with feedback structured as a collection of

nodes representing casual linked by oriented edges that represent a fuzzy-defined (empirical/subjective) usually nonlinear-quantized causality relationships between concepts. While the fuzziness and nonlinearity embedded in the FCM models allow for many real-life applications, they are also precluding more rigorous analyses of the dynamic phenomena occurring in these applications. As stated in [Kosko 1997] "the final word on them may well have to come from only trial and error or computer simulation".

## 1.7 Problem statement

The aim of this thesis is to study how Internet transforms relationships between car part suppliers and car manufacturers. Using the help of the Car Internet Research Program (CIRP) at the School of Management, University of Ottawa,, 17 semi-structured interviews of executive heads belonging to upstream suppliers in the automotive sector were considered, as means of analysis for this research. Unfortunately, interviews cannot easily be molded and analyzed with the help of precise qualitative mathematical models. Most interview analysis tools are very subjective and lack accuracy. This is in major part due to the fact they are often left to individual interpretation, using inaccurate decision tools. In order for this process to become more accurate, it must be repeated by many researchers, all following the same guidelines for means of comparison. This process can become very time consuming and expensive in the long run. An inexpensive tool, capable of accurately analyzing qualitative situations in a relatively short time frame, would therefore be recommended.

## 1.8 Proposed solution

The solution that this thesis is proposing is the use of a versatile Decision Support System called Fuzzy Cognitive Maps. This tool is capable of adequately analyzing the automotive Internet relationships previously mentioned. More precisely, the creation of 17 FCMs would serve as a basis for the analysis of the 17 semi-structured interviews. Once these maps are created, a variety of scenarios can be generated and implemented through them enabling its user to predict the impact of each new entry on the entire system.

## 1.9 Contribution

Fuzzy Cognitive Maps can serve in a variety of domains where quick inexpensive DSS are required. Their fuzzy attributes permit them to be used in a variety of circumstances that would otherwise be very inaccurately defined.

This thesis' specific contribution is axed towards the use of FCMs in the automotive world. As will be discovered later in the thesis, with the help of this tool geared towards that industry, the following advantages could be brought forth:

- Many important time consuming decisions could be performed in half the time at half the price.
- Decision taking years to predict could be forecasted in a few minutes.
- Future unforeseen costs would become apparent and could eventually be avoided.
- Unexpected situations could be accurately predicted through a series of simulated scenarios.

## 1.10 Structure of the thesis

The rest of this thesis has been divided as follows:

Chapter 2 provides a detailed overview of FCMs.

Chapter 3 will aboard the automotive industry at large, going more into depth concerning the supplier/manufacturer relationships in regards to connectivity. The last section will summarize the state of current events using a FCM and edge connection matrix, which will later serve as a basis to all experimental FCM constructions.

Chapter 4 will introduce the17 semi-structured interviews with a brief resume of each, also including their individual fuzzy maps and matrices.

Chapter 5 provides the analysis of the FCMs results.

Chapter 6 will conclude this thesis and briefly introduce possible future FCMs uses.

# Chapter 2

# Fuzzy Cognitive Maps

## 2.1 Background information

Fuzzy Cognitive Maps (FCMs) were originally developed in the world of soft computing to help study "what-if" casual relationship scenarios [Kosko 1986]. As previously mentioned, they constitute an intelligent DSS tool that owes its existence to cognitive maps.

## 2.2 What are FCMs

FCMs are cognitive maps with "dynamical systems that relate fuzzy sets and rules" [Kosko 1997, p.121]. A FCM is a fuzzy signed directed graph with feedback [Kosko 1992, p.152] structured as a collection of nodes and arcs (Figure 2.1 below). Each node is called a "concept" and represents a variable in the system. Causal concepts are linked by oriented edges (arrows) that represent the existing causality between two concepts. "Fuzzy quantized" [Petriu1995] weights are assigned to each casual relationship edge. However, one may ask one's self, if these values are imprecise (fuzzy) how does one quantify this relationship? As Stephen Mohr put it "FCMs are explicitly a qualitative tool - they attempt to capture the gross behaviour of the system without precise quantification

of the relationships in the map" [Mohr 2003]. So, in other words, Fuzzy Cognitive Maps will give us the "big picture" of a system.

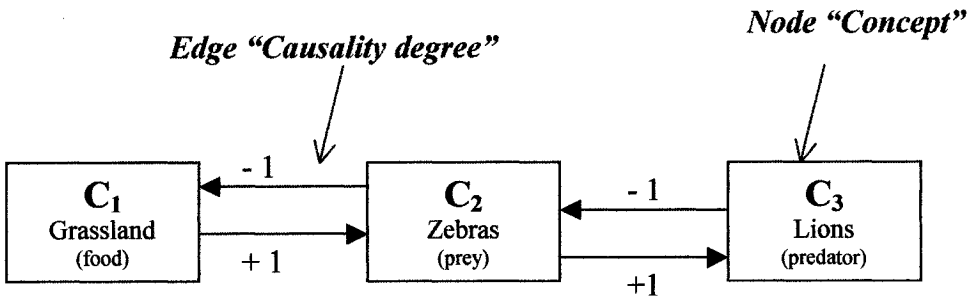



**Figure 2.1 A simple FCM**

By having a look at concept $C_2$(Zebras) in figure 2.1 [Ochoa 2003], we notice four edges (directed arrows) either entering or leaving it. Two have positive and two have negative causality degrees. The first edge starts from the grassland to the zebras, the second goes from the zebras to the grassland, the third goes from the zebras to the lions and the last one originates from the lions towards the zebras. An edge may connect any concept to any other concept. An edge may also connect a concept to itself, indicating that the future value of the concepts depends on the concept's current value.

The *connecting* oriented *edges* represent the degree-of-causality between concepts. In other words, the values indicate how much one concept causes another. These causality relationships between concepts usually can take ternary values {-1, 0. +1}. A -1 value indicates a strong negative impact, 0 indicates no impact, and +1 corresponds to a strong positive impact.

For instance $C_1$ (grassland) and $C_2$ (zebras) in figure 2.1 are connected by one positive edge (grassland to zebras), and one negative edge (zebras to grassland) indicating that $C_1$ and $C_2$ posess both negative and positive correlations. It is logical, since once grassland is activated in relation to Zebras as a source of food supply, it will increase the amount of Zebras in the area. But vice versa, if the Zebras concept is activated in relation to grassland , it will reduce the amount of grassland available to eat.

## 2.3 Edge connection (correlation) matrices

FCMs can also be interpreted with the use of an edge connection (correlation) matrix A whose elements are the fuzzy values (causality values) $a_{ij}$. Therefore the elements in the $i^{th}$ row and $j^{th}$ column of the matrix A represent the connection strength of the edge directed out of the concept $C_i$ going into $C_j$. If the edges take on discrete values from {–1, 0, 1}, it is called a simple FCM. The set of concepts $C_1$, $C_2$,..., $C_n$ defining the system under study is represented by the concept state vector C.

A state vector from a FCM at any point in time gives a snapshot of the system of concepts in the scenario being structured. By refocusing our attention on figure 2.1, we can observe that the concept $C_1$ relates to the $1^{st}$ component of the state vector and the state [1 0 0] indicates the event "grassland" has been activated. In order to permit the system to evolve, the concept state vector C is passed repeatedly through the FCM connection matrix A. This is done by multiplying C by A. The result must be further transformed using a threshold function T in order to assure the consistency of the definition domain of the state vector C.

The dynamic process of the FCM is represented as an iterative vector equation:

$$\mathbf{C(k+1) = T[C(k) \cdot A]}$$

where C(k) and C(k+1) represent instances of the concept state vector at the consecutive discrete times k and k+1, T is the threshold or transformation function, and A is the FCM connection *(correlation)* matrix.

Each individual concept in the state vector *C* has a bipolar (binary) strength value, 0 or 1, indicating the absence (inactivity) or presence (activity) of that concept in the state vector.

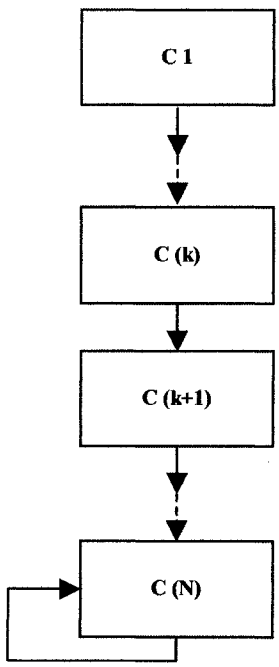
The threshold assures that both C(k) and C (k+1) are consistently defined over the same binary domain {0, 1 }, despite the fact that the matrix multiplication may generate results over a larger domain.

With this threshold transformation function, the dynamic process described by the iterative FCM can have three possible outcomes. In the first case the state vector C settles down (converges) to a fixed state of values called the "fixed point attractor". In the second case, it keeps cycling through a fixed path of states, known as the "limit cycle". Finally, in the third case the iterative FCM process indefinitely keeps producing random state vector values, also known as the "chaotic attractor" [Mohr 2003].

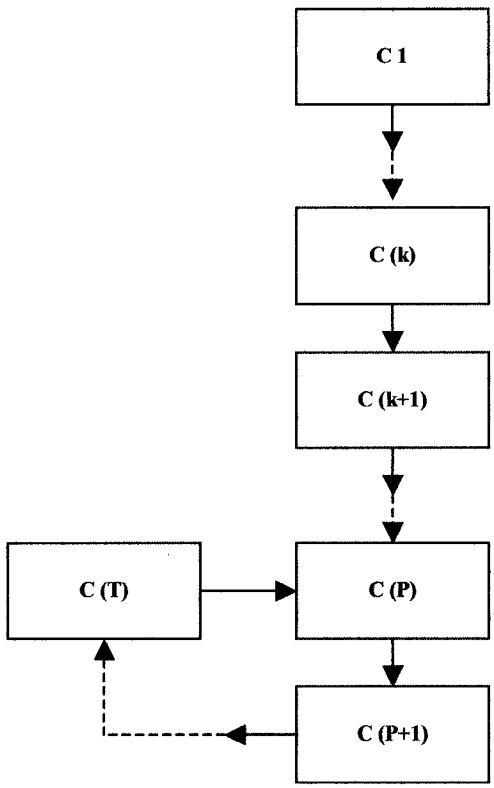
The iterative FCM process can be formally stated by the following algorithm:

1) the concept values $C_1$, $C_2$, ..., $C_n$ are set according to the current state of events;
2) the iterative FCM process is implemented by a repetitive matrix multiplication $\mathbf{C(k+1) = T[C(k) \cdot A]}$
3) the iterations continue until:

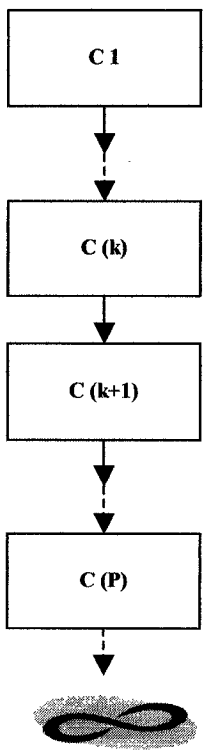
    i. the FCM converges to a fixed state (fixed-point attractor),



ii. a limit cycle is reached,




iii. the FCM never converges and continuously produces different vectors remaining entrapped in a chaotic attractor state.



Below we now build the edge connection (correlation) matrix A for our fire, water and wood example.

| | $C_1$ (Grassland) | $C_2$ (Zebras) | $C_3$ (Lions) |
|---|---|---|---|
| **$C_1$ (Grassland)** | ***0*** | ***+1*** | ***0*** |
| **$C_2$ (Zebras)** | ***-1*** | ***0*** | ***+1*** |
| **$C_3$ (Lions)** | ***0*** | ***-1*** | ***0*** |

**Table 2.1: The edge connection matrix A for the FCM given in fig. 2.1**

The elements of the edge connection (correlation) matrix A are the transposed edge causality values of the FCM given in figure 2.1:

$$A = \begin{bmatrix} 0 & +1 & 0 \\ -1 & 0 & +1 \\ 0 & -1 & 0 \end{bmatrix}$$

Applying the iterative algorithm to the FCM shown in figure 2.1, using the state vector [1 0 0]and a threshold (T) of 0.5* gives the following results:

$$C \cdot A = [1 \quad 0 \quad 0] \begin{bmatrix} 0 & +1 & 0 \\ -1 & 0 & +1 \\ 0 & -1 & 0 \end{bmatrix}$$

* T being equal to 0.5 means that anything $\geq 0.5 = 1$ and that anything $<0.5 = 0$

| | | | | |
|---|---|---|---|---|
| The result for case | C1= [1 | 0 | 0] | is |
| Matrix multiplication result | C2=[0 | 1 | 0] | |
| Normalized vector | C2=[1 | 1 | 0] | |
| Matrix multiplication result | C3=[-1 | 1 | 1] | |
| Normalized vector | C3=[1 | 1 | 1] | |
| Matrix multiplication result | C4=[-1 | 0 | 1] | |
| Normalized vector | C4=[1 | 0 | 1] | |
| Matrix multiplication result | C5=[0 | 0 | 0] | |
| Normalized vector | C5=[1 | 0 | 0] | |
| **Normalized vector** | **C1=[1** | **0** | **0]** | **Previous Identical state** |

The system stabilizes to the limit cycle C1 – C4. We can interpret the limit cycle as follows. The grassland is very abundant (C1), represented by the grassland concept set at [**1** 0 0] showing activity. This permits a growth in the zebra population due to the larger amount of grassland to feed off of (C2), represented by the activation of the zebra concept [1 **1** 0]. This in turn permits the lion population to grow due to the larger amount of zebra to feed off of (C3), represented by the activation of the lion concept [1 1 **1**]. Which ends up diminishing the amount of zebras in the area, (C4), represented by the 0 activity of and zebras [1 **0** 1], which in turn diminishes the amount of lions left due to the new lack of food, (C5 =[1 0 0]). As a result, the system ends up returning to the original state of abundant grassland (C1 = [1 0 0]). Straightforward answers such as the above ones are not always easy to obtain in one's every day life scenarios. According to Mohr, "A limit cycle gives a realistic outcome that a user may face in any given situation. In the case of FCMs with continuous transformation functions and concept values, the possibility of a resulting chaotic attractor can actually be beneficial. By feeding the simulation environment with a multitude of possible events, a realistic effect can perhaps be obtained" [Mohr 2003].

## 2.4 Applying Fuzzy Cognitive Maps to Research Analysis

FCMs can be based on a variety of problem scenarios that have been interpreted in many forms. It can be based on interviews, on textual descriptions, on witnessed events. As long as the source of the information is highly credible (expert opinion), a FCM can then be accurately modeled from these scenarios. Once the information is collected, one must then proceed to identifying the key factors/concepts that are correlated to the problem. Continuing in the same direction, one must then identify the causal relationships among these factors/concepts. Experts can then give their interpretation of the causality values that should be associated to each group of interacting concepts. Then, either by the creator of the FCM or an expert, these estimates can be translated into numeric values in the ternary range [-1,0,1], or any other chosen standard. These steps lead us to a diagrammatic representation of FCM, which will later be converted into a corresponding edge connection matrix. A panel of experts can contribute to creating many FCMs with different concept nodes and causal links. For greater accuracy one can even give different degrees of credibility to each expert that can then be factored in to the causal link strength that they have established.

To ascertain the validity of a fuzzy cognitive map we would have to compare the outcome of the simulations with the actual effect of the event being modeled. If the fuzzy cognitive map, as it is, does not prove good enough to predict the behaviour of the actual system that is being modeled, then it would be necessary to fine tune the model. The fine-tuning of the fuzzy map can be done by adding more factors, by rearranging the causality relationships or by modifying the intensities of effect.

# Chapter 3

# The automotive industry

## 3.1 A brief history of current events

The first vehicle running on its own power dates back to 1769. It was designed by Nicolas Joseph Cugnot and constructed by M.Brezin. The vehicle ran using a steamed powered engine and averaged 2 miles per hour [Bottorff 2000]. Today's automobiles run on gasoline, and hybrid gases and they can surpass 200 miles per hour. The technology has greatly evolved but the end use remains the same, transportation. The combination of current technological advancements and world globalization has made the car industry a very complex business environment. As previously mentioned, big car manufacturers and suppliers have the monopoly in this industry. They pave the roads that all others must follow. Like in many other sectors, as the turn of the century approached major investments where made in computer and hardware technologies and especially in Internet based technologies permitting better connectivity and communication among all automotive players. Unfortunately, just one or two years after, a major technological crash hit North America and the world. Everyone suffered part of the aftershock, some more then others. Meanwhile, North American manufacturers' car sale volumes, which were already in decline, dropped to all time lows. People started backing away from companies such as Chrysler, Ford and GM, going towards more reliable Asian built vehicles. For one, these factors pushed North American manufacturers into pursuing

major cost reductions. Chrysler even had to shut down some of its plants and lay off many workers, while imposing major cost reductions unto all its suppliers. This creates even greater repercussions. Many manufacturer/supplier contracts are breached, on behalf of the manufacturers, and relationships of trust and confidence are quickly disappearing. Meanwhile, carmakers are also trying to impose new Internet communication tools, which they invested millions into acquiring, upon their suppliers. Yet, after the high-tech crash, suppliers have become highly sceptical of technology and its capabilities [Navarre 2003].

The other solution all OEMs had to implement in order to assure growth and prosperity is alliances and fusions. Towards the mid to late 1990's, major alliances were made with various big automotive players. Chrysler and Daimler-Benz joined together to form Daimler Chrysler, Ford and Mazda joined together to form a joint venture called Auto Alliance. Even Toyota and GM decide to help each other by creating Nummi (New United Motor Manufacturing Inc). By sharing manufacturing facilities, equipment and processes companies have managed to reduce costs, all the while increasing productivity and quality [Harbour 2002]. Carmakers and suppliers that use innovative techniques tend to remain ahead of the game.

## 3.2 Manufacturer/ supplier relationships

Manufacturer/supplier relationships are mostly unidirectional, for the Original Equipment Manufacturers (OEMs) hold the power. As previously mentioned in the introduction, only major suppliers have the ability to keep control of their own operations. As a general guideline, the bigger the supplier the closer the relationship is to OEMs. On the other

hand the smaller the supplier, the less he is tied to OEMs. Most small suppliers only deal directly with other suppliers and, therefore, are less concerned about the bigger fish surrounding the automotive sea. All this power and manipulation has led to much criticism and fear on behalf of the majority of suppliers. Confidence and trust have been replaced by demands and impositions. Under the pressure of manufacturers, suppliers have had to become distributors of complex services. According to interview feedback that will follow in the subsequent chapter we will see how the manufacturer policies are now based on: Price-Service-Quality-Delivery at low cost with high reliability, rather than on quality and service first and foremost. The OEMs have developed qualification tools (QS 9000 and ISO) that are being forced down the supply chain. This gives them the added assurance that even though close manufacturer/supplier relationships no longer exist, quality will still be maintained [Harbour 2002].

## 3.3 Connectivity issues from a supplier's perspective

As explained in the previous sections, at the present time most car suppliers are in a critical state. Their main concern is to provide their clients with the requested orders at, if possible, the requested quality and price range. This leaves very little room for innovation and research and development in regards to connectivity. Most suppliers are so preoccupied at slashing costs while at the same time trying to remain profitable that they have no time to assess Internet based solutions. OEMs, on the other hand claim information technologies are what suppliers currently need to help further reduce costs and increase margins. Goldman Sachs reported that from a business to business (B2B) perspective, connectivity could save the North American car industry up to 1000$ per

vehicle [Navarre 2003]. But many suppliers remain sceptical of such optimistic results. Most of them claim these technologies are being adopted at a very slow pace. Many reasons can be given to explain these delays. The main one that seems to continuously resurface is lack of standardization. Every manufacturer adopts personalized design and software platforms that he wishes to impose unto all the supply chain. Suppliers are stuck adopting a multitude of standards to accommodate their many clients' needs. This does not encourage the adoption of new connectivity tools when odds are they will not be integrated and assimilated by all. Now, if everyone were to share one standardized Internet protocol, other issues would still block the path to collaborative improvements. Who controls the network? Can security be guaranteed? How do we prevent automotive espionage from happening now that things are so much more transparent? How can trust exist, when OEMs are breaching contracts and relationships of confidence left right and center? Although, according to some researchers, future implementation of better connectivity relationships would greatly enhance current issues, many unanswered questions must first be addressed. The following chapter will take us directly into the minds of the very people facing these topics. Through it, we will find out how they feel and react to the fast changing complex environment of the 21$^{st}$ century automotive world. But prior to passing on to the next chapter, let us get a first hand glimpse of what the current state of events looks like on a FCM.

## 3.1 FCM representing the current state of events in the automotive industry from a supplier's point of view.

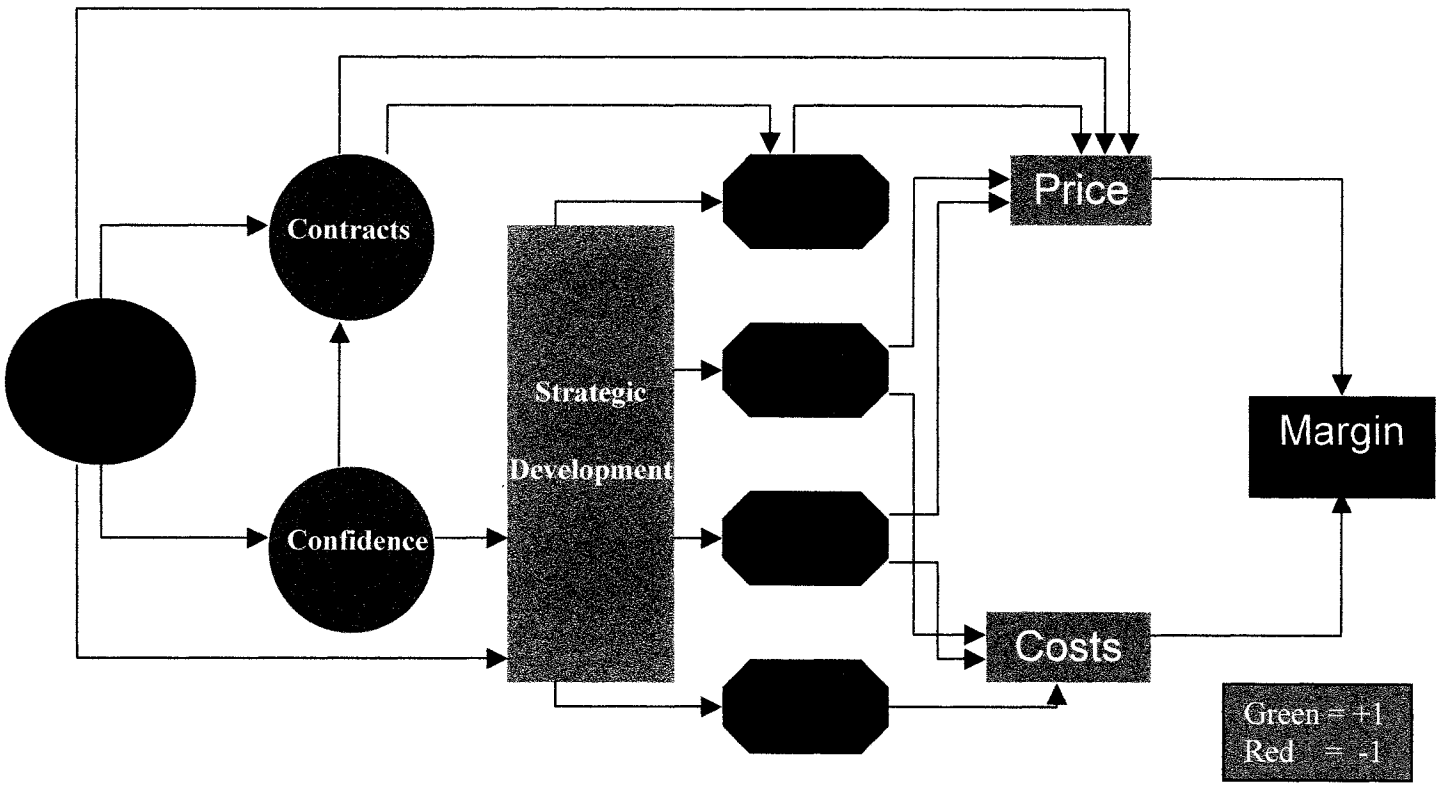



**Figure 3.1 : Current state of the automotive industry from a supplier's point of view**

The FCM that is illustrated in figure 3.1 depicts the concepts and causality relationships that where covered in the previous paragraphs. The map and all its values were created by using the input of a compendium of automotive experts, which has been summarized in another research paper written by Christian Gondolf [Gondolf 2001]. The model was created using the following steps:

1. Analysis of the interviews, focusing on extracting the relevant variables. This extraction is done based on the analysis of the interviews content.

2. Establishing a base of the relationships among the various variables. Suppliers are essentially defensive and defending their margins is at the heart of their strategy. In other words, they focus on defending their prices and/or their costs. Prices and costs are independently or jointly influenced by a series of variables that are also organized in subsystems (see figure 3.1 below). The impact of Internet connectivity tools was singularized and treated as an exogenous variable to the model. The proposed model takes into account this problem statement.

3. Proofing the model. The proposed model was presented to automotive experts and professionals, members of CIRP, in order to establish its credibility. It was immediately declared as reliably representing the problematic relationships that exist between manufacturers and suppliers, as well as the effects of the new manufacturer Internet technologies, notably the negative effects of reverse auctions and the general negative perception of COVISINT.

Therefore, it can be deducted that the FCM and all its associated parameters have a very high degree of credibility and accuracy. Now that the FCM has been created, we can model the edge connection matrix that corresponds to it.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | -1 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 |
| 11)Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 3.1 : Automotive industry edge connection matrix, from a supplier's point of view**

Since the FCM from figure 3.1 and its corresponding edge connection matrix represent an accurate snapshot of the current state of events from a supplier's perspective, it will serve as a blueprint for the construction and interpretation of 17 FCMs and connection matrices that will be modelled in the subsequent chapter.

# Chapter 4

# The car supplier interviews

## 4.1 Data collection and analysis methods

As Christian Gondolf, University of Ottawa researcher, has quoted in his summary paper, regarding the 17 semi-structures interviews, "From September 1st to October 10th, 2001, CIRP organized a series of 17 semi-structured interviews of executive heads belonging to upstream suppliers in the automotive sector. The goal of this series of interviews was to fine-tune our understanding of the sector in order to prepare survey tools" [Gondolf 2001]. Interviews generally lasted from one to two hours. In some instances they lasted longer due to the greater number of people involved. The interviewees were:

1. **ABC GROUP**, Rexdale (Ontario), Nancy Talbot, Assistant IT Manager
2. **CAMOPLAST**, Richmond (Quebec), Jocelyn Huot, VP General Manager
3. **CPI Plastics**, Mississauga (Ontario), Doug Creelman, Divisional Manager, OEM; ROB Woods, Director of Engineering, Clive Parham, Divisional Sales Engineer OEM Automotive
4. **DECOMA**, Concord (Ontario), Chris Rolko, Director, Purchasing and Continuous Improvement
5. **DEPCO International Inc.**, Mississauga (Ontario), Glenn Penney, Director of Administration
6. **DOMINION SPRING**, Mississauga (Ontario), John Bosnali, General Manager, Boris Harmic, Information Systems Coordinator
7. **FISHER GAUGE Ltd**, Peterbourough (Ontario), Brian Baker, Information Manager

8. **FREEWAY WASHER Ltd**, Mississauga (Ontario), Rogers Alfred, Director of Operations
9. **HUNJAN Group of Companies**, Markham (Ontario), Baljit Sierra, Executive VP
10. **IPL**, Saint Damien De Buckland (Quebec), Michel Lanoue, Director Automotive and Customs Molding-Industrial Division; Marlène Laflamme, Coordinator Custom Molding; Jean-Louis Bodin, IT Manager
11. **ISPAT**, Montréal (Quebec), Isabelle Lemay, IT Manager
12. **ITW Deltar Canada**, Concord (Ontario), Steve Caldwell, Sales Manager
13. **LAGRAN Canada Inc.**, Brossard (Quebec), Robert Belanger, VP Sales and Marketing
14. **MONTUPET Ltée**, Rivière-Beaudette (Quebec), André Visokis, Technical Director
15. **RAMSDEN Industries Ltd**, London (Ontario), (non-member APMA), Bob Ramsden, President
16. **THE WOODBRIDGE GROUP**, Mississauga (Ontario), Carol Dickson, VP Business Development and Systems Integration
17. **TYCO ELECTRONICS**, Markham (Ontario), Sam Alesio, Business Unit Manager Motor Vehicle Division

Following the data collection undertaken by Christian Gondolff, we proceeded to summarizing each of the 17 semi-structured interviews. To keep the reader focused on the subject at hand, the summaries, data collection and analysis will focus only on the issues that concern this study. Therefore only the state of current events and relationships in regards to connectivity issues will be covered. After each summary, we made a FCM and edge connection matrix out of each one, using the FCM blueprint as a reference guide.

Three new concepts are added to the original edge connection matrix blueprint to better interpret interview results in accordance to connectivity. *Collaborative design (CD)* , *supply chain management (SCM)* and *reverse auctions (RA)* have been selected as the three main e-business concepts because they appear to be the most practical new entrants in the current automotive industry [Navarre 2003].

To insure an objective and fair interview to FCM and matrix transposition, one must assume a controlled and standardized approach. Unfortunately, due to the unorganized nature of the semi-structured interviews this remained impossible. Nevertheless, the rudimentary set of rules, shown below, where devised to attempt keeping as much objectivity as possible

1) Companies that have heard of e-business will have active e-business concepts (green arrows meaning in positive correlation +1 or red arrows meaning in negative correlation -

2) Out of the companies who have heard of e-business only those having fully implemented one of the three new concepts (CD, SCM, RA), shall have that/those illustrated with the use of full green or red arrows (see interviews below for examples).

3) All companies having heard of e-business and showing interest towards implementation of one or more concepts shall have doted green or red arrows, representing the wished connectivity relations. This shall differentiate FCMs of companies, which already posses one or more of the three connectivity tools from those who wish to acquire them. However, in the edge connection tables there is no distinction between wanting and having these tools (All active concepts posses a + 1or – 1 sign).

4) All of the original 11 concepts remain unchanged unless the interviewee clearly indicates a deviation from the blue print, in which case the corresponding implicated concept would be modified in accordance to the interviewee's feedback (see FCMs and Matrices below for examples).

Once the 17 edge connection matrices are completed, they can then be stimulated by vector/matrix multiplication permitting us to extrapolate a variety of other possible outcomes. This will be covered in the next chapter.

**Appendix A contains the verbatim for the ABC group interview, as well as an edited version which serves as an example as to how the FCM for that automotive supplier has been optained.

## 4.2 The summarized interviews and their FCMs

### ABC Group

*ABC Group – Nancy Talbot – interview summary September 09, 2001.*

Nancy Talbot, the assistant manager in the IT department, explains that ABC is a customer driven company that specializes in the production of plastic interior/exterior car parts. It is a privately owned Canadian company possessing locations in various regions of the world such as Spain, Germany, Brazil and Japan. Nancy states that ABC is connected electronically to all its OEMs using various technologies, such as EDI, ANX and EDS, depending on the manufacturer's requests and desires. GM for example, is linked to ABC electronically using EDS, as well as through a specific Internet system called the "Supply Power". Chrysler, on the other hand, requested ABC to use Power Ware by Covisint, which is another form of Internet based network. Mrs. Talbot admits that for the time being Covisint is mostly used for e-procurement (reverse auctions). Collaborative product designs are another area where Covisint could become useful but because of a lack of standardization, OEMs such as Ford and Chrysler, ask ABC to use a CAD system instead. At the present time very few companies impose Covisint on to their business partners. For the time being ABC, like many other suppliers, has not yet researched or analyzed the possible benefits of better connectivity. In the present context, suppliers are more preoccupied satisfying and obeying their client's needs rather then finding the best ways to reduce their own costs. Manufacturers in general tend to be more inclined to using their own network protocols because they believe it to be more secure. This is one of the major reasons connectivity standards are still nonexistent in the automotive industry (see Appendix A for a sample of this interview).

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | -1 | 0 | **+1** | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | **-1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.1 : Automotive industry edge connection matrix, from ABC's Group point of view**

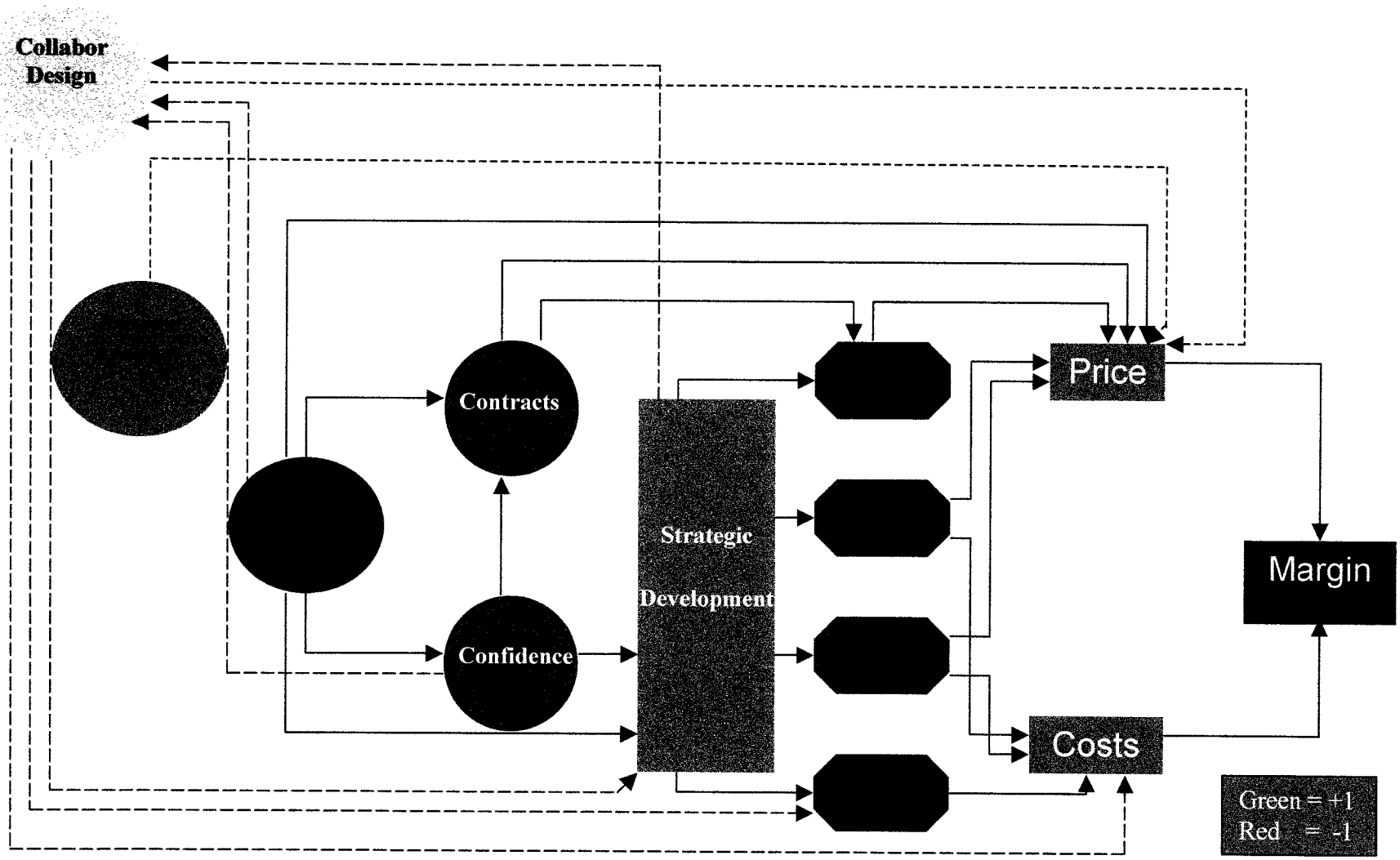



**Figure 4.1 : Current state of the automotive industry from ABC's Group point of view**

## Camoplast

*Camoplast – Jocelyn Huot – interview summary October 2, 2001.*

Camoplast is a diversified private Canadian enterprise that was created in 1982 by acquiring former Bombardier Inc manufacturing divisions. Camoplast was, at that time, composed of four manufacturing divisions, rubber (caoutchouc), fashion (mode), composites and thermoplastics, hence the name "Ca-mo-plast". The thermoplastic division focuses on the automotive industry in which it creates alloy based interior and exterior vehicle parts for OEMs and car suppliers. Camoplast's General Manager, Jocelyn Huot, explains that the fashion division along with other smaller manufacturing sites, are no longer part of company's portfolio due to budget cuts that were inevitable considering the economic crisis surrounding the automotive industry. To compensate for the hard times, meanwhile still taking advantages of their power, OEMs are imposing considerable price cuts onto their suppliers who end up taking most of the economic burden. This will eliminate many weak suppliers leaving room for only the strongest which will monopolise the rest of the market. Camoplast uses EDI with it's manufacturers and suppliers and is in the process of evaluating Covisint for connectivity issues. Reverse auctions and collaborative design are also features that are available through current connectivity technologies. However, these technologies are new and in need of better development, in addition they only work in favour of the OEMs. For the time being Covisint is therefore perceived as a cost center more than anything else claims Mr. Huot. Connectivity is therefore limited to privatized networks between the suppliers and their key players rather then through common Internet usage.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | -1 | 0 | **+1** | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | **-1** | 0 | **+1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.2 : Automotive industry edge connection matrix, from Camoplast's point of view**

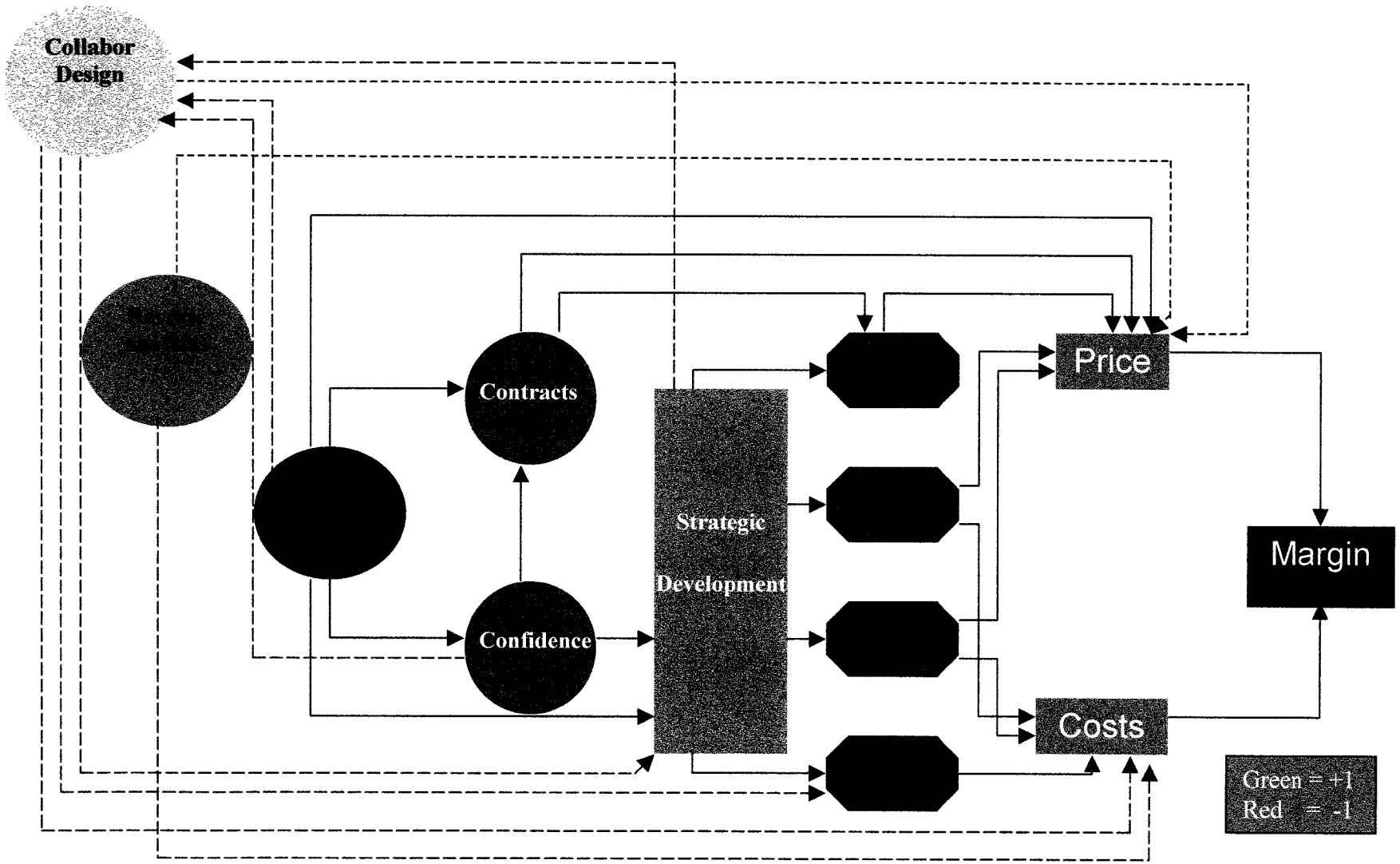



**Figure 4.2 : Current state of the automotive industry from Camoplast's point of view**

## CPI Plastics Group Limited

*CPI Plastics Group Limited – Doug Creelman, Rob Woods and Clive Parham – interview summary September , 2001.*

CPI is a leading North American supplier of extruded thermoplastic systems, functional components and decorative trims. It is a publicly owned company that was founded in 1974 in Mississauga Ontario. Doug Creelman, the divisional manager, states that, as a relatively small player, CPI faces difficult price and volume reductions from its OEM's and other supplier clients. The major issue alleviating an already tense industry is the lack of trust, confidence and loyalty that exist between the suppliers and their manufacturers. Manufacturers are in win-win situation where they get what they want form their suppliers or they discard them and find new ones for cheaper. Long term contracts no longer have meaning, because OEMs void them the second they find a more appealing offer. New Internet technologies, permitting reverse auction and collaborative design, such as Covisint, which was introduced by the big three (GM, Ford, Chrysler),claim to be able to help reinforce supplier/manufacturer relations, while lowering general costs. Alas, suppliers end up with little or nothing while the OEMs reap all the profits. Reverse auctions offer no feedback; the OEM and online winner communicate regardless of how much efforts were put in by other suppliers. Collaborative design would be beneficial, if trust and loyalty existed between car constructors and their suppliers but that is not the case. At the present time, very few companies use Covisint with their clients and business partners . For the time being, CPI plastic group limited, like many other suppliers, has not yet researched or analyzed the possible benefits of better connectivity, due to abuse and distrust that saturates the industry.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | **+1** | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | 0 | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.3 : Automotive industry edge connection matrix, from CPI's Group point of view**

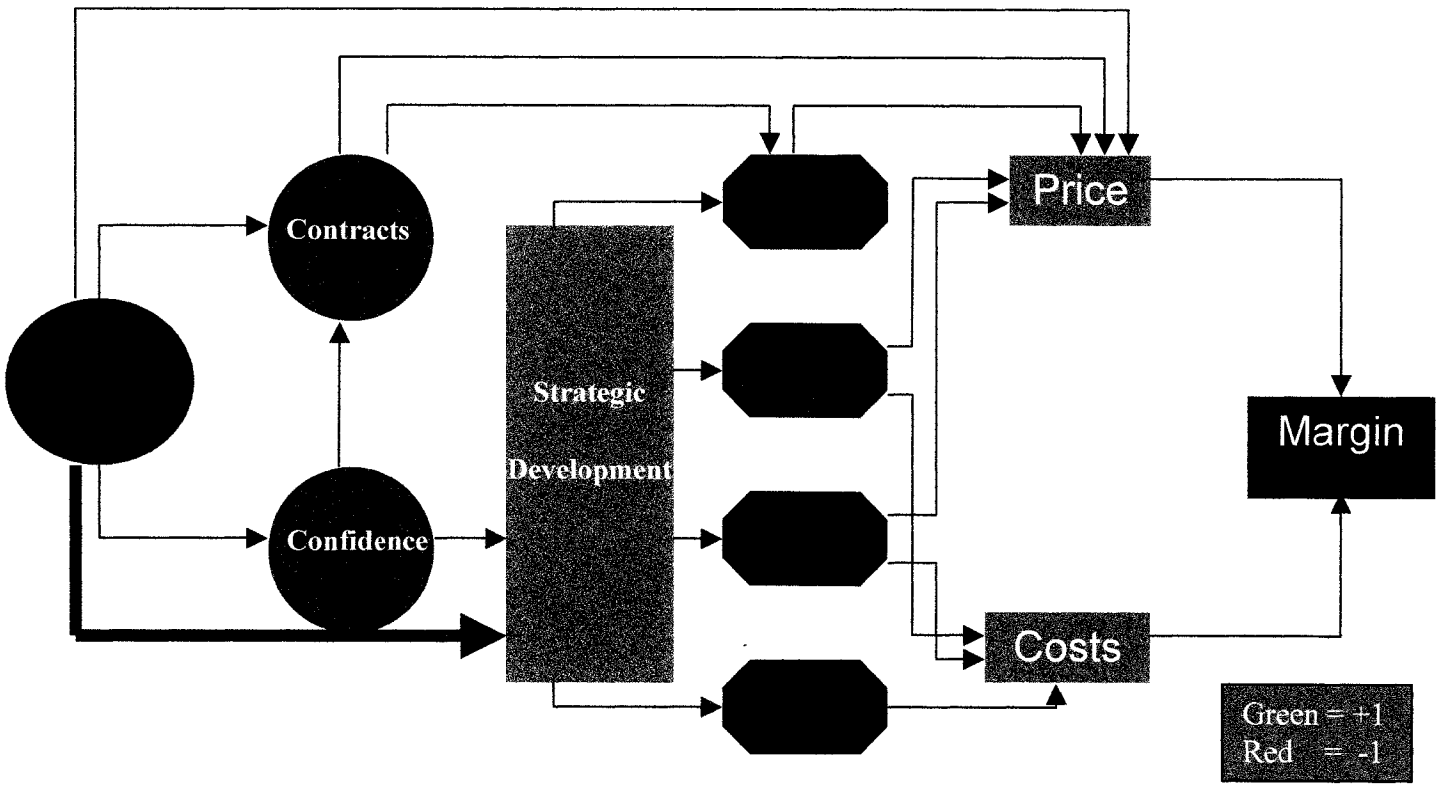



**Figure 4.3 : Current state of the automotive industry from CPI's Group point of view**

## Decoma International Inc

*Decoma International Inc – Chris Rolhio – interview summary September 25 , 2001.*

Decoma is a full service supplier of exterior vehicle appearance systems for the world's automotive industry. After over twenty years of existents, Decoma has approximately 14,000 employees in 41 manufacturing, engineering and product development facilities in Canada, the United States, Mexico, Germany, Belgium, England, Japan, France and the Czech Republic. Chris Rolhio, their director of purchasing and continuous improvement, explains that cost pressure during the last year has been extremely prevalent. "Take Daimler Chrysler for example, he says. It has unilaterally imposed a 5% reduction on all purchase orders to all its suppliers". The North American OEMs are suffering, due to a loss in sales being taken over by the Japanese (Honda, Toyota) and European (VW,...). The losses are passed down the line to their suppliers, which try to pass them down even further. These circumstances lead to more problems, since confidence and trust no longer exist between suppliers and manufacturers. Manufacturers breach contracts as soon as a better deal comes along. Rolhio states that they try to compensate for the cuts in as many ways and forms as possible. One possibility to reduce costs is enhanced connectivity between all parties. Decoma, is connected electronically to all its OEMs and most of its suppliers using various technologies, such as EDI, Synap, SupplyWeb, Supply Solution and even Internet based depending on the manufacturer's requests and desires. The director of continuous improvement admits that, for the time being, however, Internet based tools are limited and underdeveloped. Covisint is an Internet tool developed by the big three (Ford, GM, Chrysler) mostly used for e-procurement (reverse auctions). Decoma has no use for such a tool because it is mostly used for commodities which is a

very small part of its business. Collaborative product design, which is another Internet connectivity tool, greatly interest Decoma, but because of a lack of information and development, it will take time to integrate. At the present time, very few companies impose Internet tools such as Covisint on to their business partners. Chris Rolhio says that before a company can invest in technology and automization, it must first have established a firm business process as well as good partnerships. How can one collaborate electronically, if one cannot even team up through traditional methods? Decoma has high hopes for connectivity technologies, but first human connexions must be reinitiated and reinforced.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | **+1** | 0 | **0** | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | **+1** | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.4 : Automotive industry edge connection matrix, from Decoma's point of view**

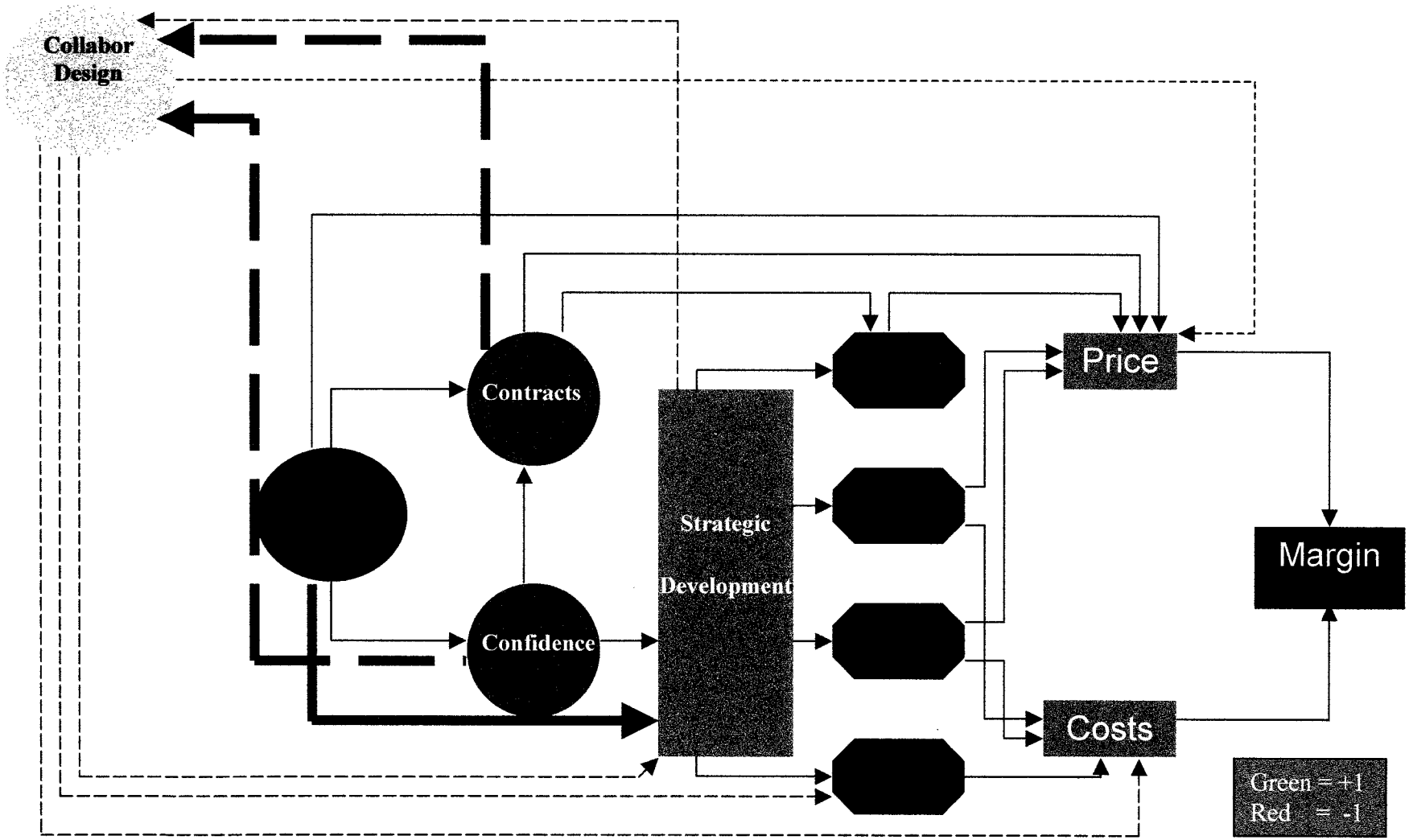



**Figure 4.4 : Current state of the automotive industry from Decoma's point of view**

## Depco International Inc

*Depco International Inc – Glenn Penney – interview summary September 17, 2001.*

Depco International Inc is an automotive supplier that was established in 1963. It specializes in supplying decorative metal and extruded products, plastic injection molded and finished exterior products, as well as interior trim products and assemblies to customers throughout North America. Like many others in the industry, Depco feels enormous pressure from clients (manufacturers and other suppliers) regarding costs. As Depco's financial director Glenn Penney explains, this forces companies to start consolidations with each other to assure growth and survival. This enterprise has recently started using EDI with its major manufacturers and suppliers but is still far from being ahead of the game regarding current connectivity technologies. Reverse auctions and collaborative design in relation to Covisint are concepts still on the drawing board for Depco. They plan on implementing these processes within the next 12 to 18 months and are still unconvinced of the major advantages they may bring forth.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.5 : Automotive industry edge connection matrix, from Depco's point of view**

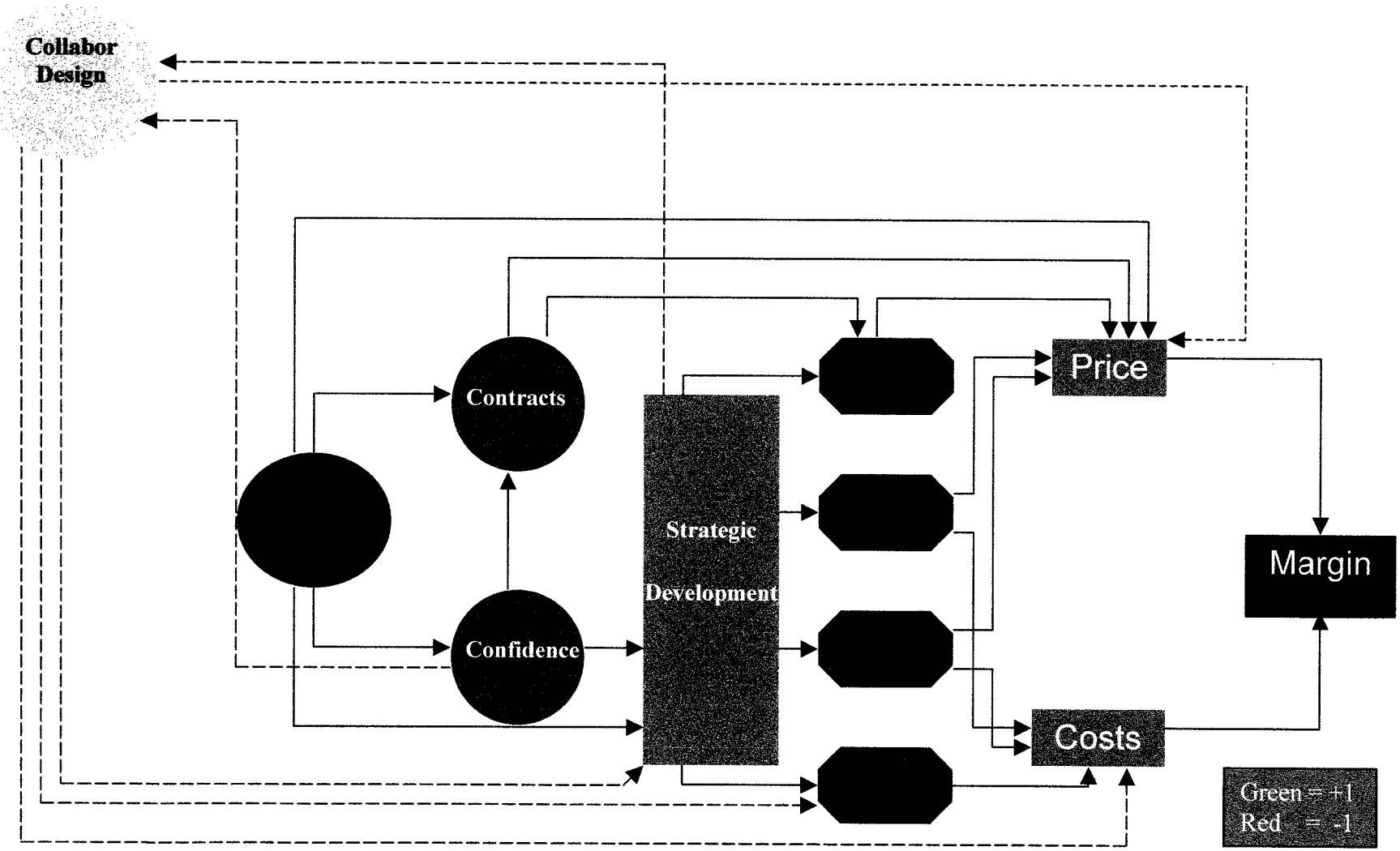



**Figure 4.5 : Current state of the automotive industry from Depco's point of view**

## Dominion Spring Industries Corporation

*Dominion Spring – John Bosnali – interview summary September 25th, 2001.*

Industry Corporation (DSI) has been in the spring-making business for over 20 years. DSI is a top supplier of numerous types of mechanical springs, wire forms, stampings and light assemblies to the North American automotive market. Roughly eighty five percent of the company is dedicated to the automotive industry and the other fifteen percent to non-automotive sectors. Its General manager John Bosnali says the whole industry is in a recession right now. OEMs are suffering and so they pass the burden down the line. Cost reduction is the number one priority in the industry. Dominion Springs controls its costs, in part by continuing the tumble down onto their suppliers, while at the same time controlling their own processes, as much as possible. Connectivity is another path that is being explored to save on costs. DSI already uses various connectivity tools such as EDI to communicate with its clients but many new tools are arriving which are promising to save even greater costs. Reverse auctions and collaborative design Internet tools are but a few examples of new cost saving technologies. Mr. Bosnali explains that DSI has been participating in reverse auctions for about a year without noticing the benefits that are being advertised. He says they compete against other suppliers and perhaps even the OEM, organizing it to further reduce its costs. There is no feeling of confidence using such a tool. It appears that only the OEMs are ripping the profits with such a tool. DSI also posseses a collaborative design tool with some customers but it is not a very advanced system. Due possibly to the fact that DSI does not supply OEMs directly, it was unaware of Covisint. Until others prove the benefits of Covisint and start imposing it, Dominion Spring has no reason to invest in such a tool.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | **+1** | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | **-1** | 0 | **+1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.6 : Automotive industry edge connection matrix, from Dominion Spring's point of view**

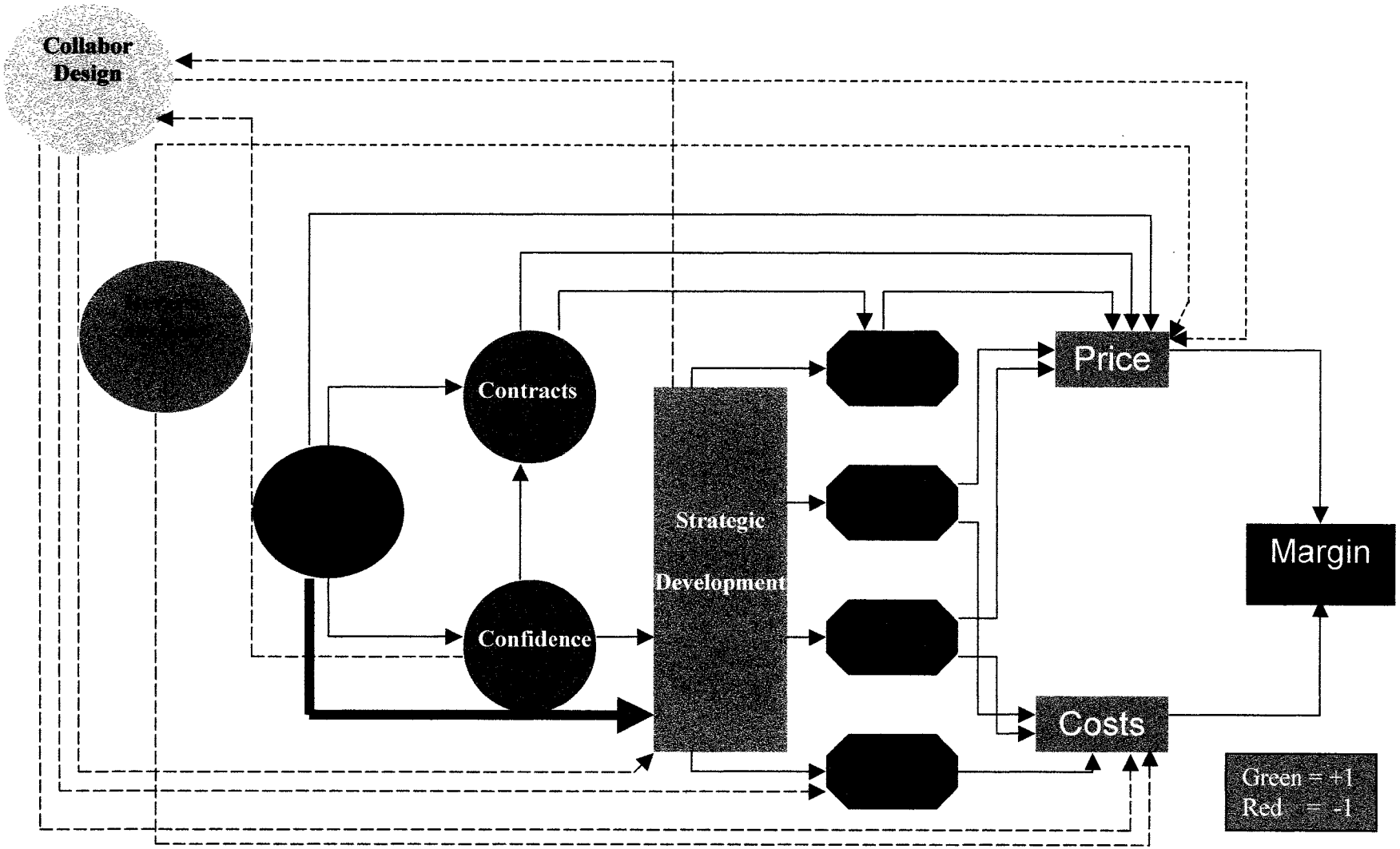



**Figure 4.6 : Current state of the automotive industry from Dominion Springs's point of view**

## Fisher Gauge Ltd

*Fisher Gauge - Ryan Becker - September 18, 2001*

Toolmaker and designer Bill Fisher founded Fisher Gauge Limited in 1943. Fisher Gauge Ltd has now been renamed FisherCast Global. It is a world leader in the design and production of high precision zinc and magnesium alloy die cast components and die cast component assemblies. With production facilities in North America and the United Kingdom, FisherCast Global serves many OEMs and suppliers in the automotive industry, as well as in many other fields. Ryan Becker, information manager at FisherCast, summarizes the current state of events in the following words "every customer is asking every supplier for extended terms and price drops ranging from 5% to 30%". He then adds that car builders are cutting down their orders, while still demanding more inventory be stocked and produced to assure just in time stock availability. FisherCast is currently trying to integrate Internet based connectivity tools to its supplier/customer relation's portfolio but has yet to research or study its effects. However Mr. Becker believes there can be some benefits to implementing such a technology in partnership with its customers. Covisint is one example of a future multimedia Internet tool that Ryan Becker's company is considering using more in depth. On the other hand because FisherCast Global is such a specialized supplier, it has no need for certain aspects, such as reverse auctions, that Covisint offers. Globally FisherCast is a company that is driven by its customer's demands, therefore until new Internet tools become mandatory to do business they are not a priority on their list.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | 0 | +1 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.7 : Automotive industry edge connection matrix, from Fisher Gauge's point of view**

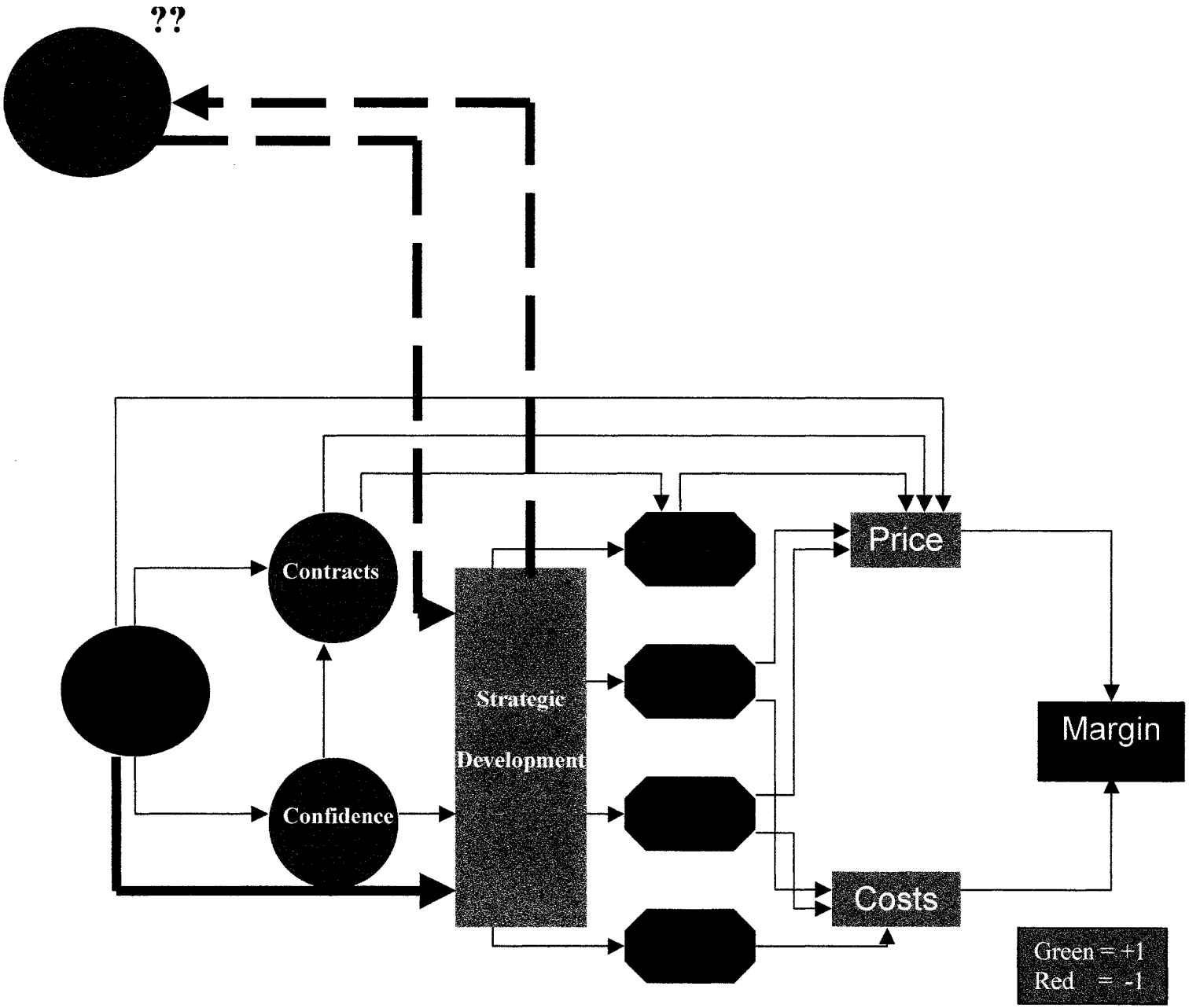



**Figure 4.7 : Current state of the automotive industry from Fisher Gauge's point of view**

## Freeway Washer Limited

*Freeway Washer Limited – Roger Alfred – interview summary September 17th, 2001.*

Freeway Washer Limited is an American based corporation out of Cleveland, Ohio. It has manufacturing facilities in Rockford, Illinois, Keighley, West Yorkshire(U.K) as well as Mississauga, Ontario ( Canada). Freeway Washer specializes in providing automotive suppliers and OEM's around the world with washers, retaining rings, stampings and commercial bearings. While most of the automotive industry is suffering major cost pressures, Freeway manages to have an 11% profit growth from its best year. Its secret is diversification. Only 64% of Freeway serves the automotive industry while the other 36% is dedicated to a variety of fields (Bombardier, Black&Decker...). Its director of operations, Roger Alfred, explains that apart from being well diversified and not having many competitors Freeway uses Internet connectivity tools to bring down its costs. Like the majority of suppliers in the automotive industry, Freeway has been using EDI as a standard connectivity tool. However this technology is getting outdated and Internet is a much cheaper way to share information. It offers many possibilities, such as reverse auctions, collaborative designing and advanced supply chain management. Reverse auctions only seem to help eliminate profits from all its participants, explains Mr. Alfred who has been involved in four. The only real beneficiary is the auction provider who greedily steals all major profits. In such aspects, connectivity seems to be killing real human relationships. The director of operations admits that from his point of view collaborative designing is the key reinforcing technology that is needed to reduce costs and strengthen relationships. At Freeway Washer Limited it's about good quality, good relationships equaling 100% customer satisfaction.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | **+1** | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | 0 | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | **-1** | 0 | **+1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.8 : Automotive industry edge connection matrix, from Freeway Washer's point of view**

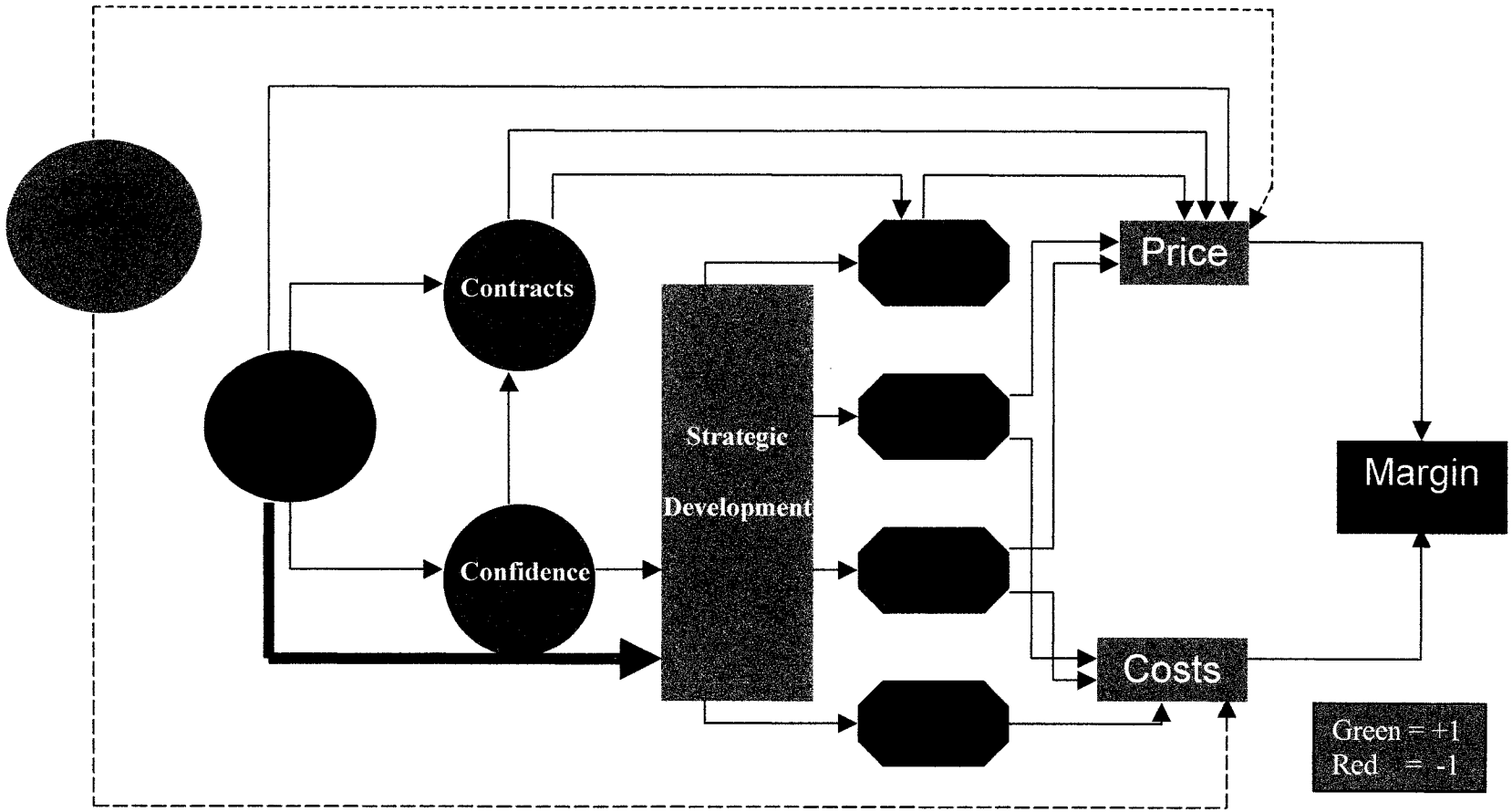



**Figure 4.8 : Current state of the automotive industry from Freeway Washer's point of view**

## Hunjan International Inc

*Hunjan International Inc – Baljit Sierra– interview summary September 17, 2001.*

Hunjan International Inc. is an automotive parts supplier. Hunjan International consists of Hunjan Tools & Mould Ltd., which designs and manufactures plastic injection moulds, and Hunjan Moulded Products, a custom injection moulder. Ninety percent of the company is dedicated to the automotive industry and the other ten percent to non-automotive sectors. Its executive VP Baljit Sierra says that if a company can compete successfully in the automotive industry facing today's harsh circumstances, it can compete in any industry. Cost reduction is the number one priority in the industry right now but Hunjan refuses to sacrifice its quality and customer satisfaction for it. Instead it plans ahead and shares costs with its own suppliers which greatly helps reduce cost pressure. Mr. Sierra says, "In an industry where you can't afford not to work with your customers, you have to be able to form partnerships, and that is where you both benefit." Hunjan International uses various tools such as EDI to communicate with its clients and various suppliers. Though many connectivity tools exist there is a major lack of standardization between the various manufacturer/supplier tools. Covisint is a promising new standardized connectivity tool that Hunjan International has not yet considered. It claims to be able to improve collaborative design, the supply chain and e-procurement (reverse auctions), which would altogether greatly reduce costs. At the present time, Hunjan International Inc remains sceptical to the benefits of such a tool. Until others prove the benefits of such technologies, they will remain underused by suppliers such as Hunjan.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | **+1** | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.9 : Automotive industry edge connection matrix, from Hunjan's point of view**

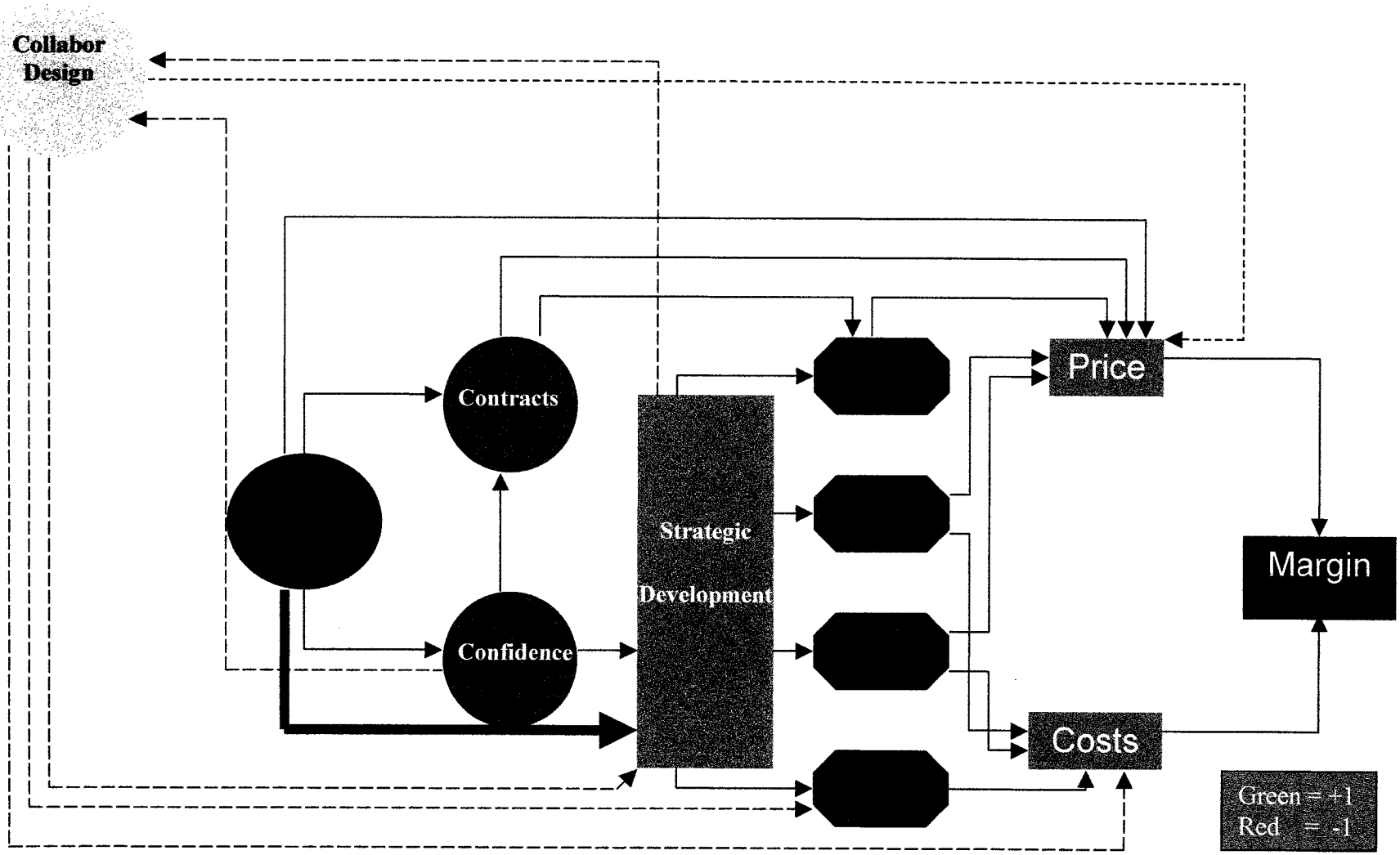



**Figure 4.9 : Current state of the automotive industry from Hunjan's point of view**

## IPL Inc

*IPL Inc – Michel Lanoue et Jean-Louis Godin– interview summary September, 2001.*

IPL Incorporated is a North American producer of molded plastic products that was founded in 1939. The company employs more than 1,100 persons and markets over 400 products that it supplies to various industrial sectors. It has served the automotive sector for just over 20 years now. IPL produces various parts such as: frames with integrated sealing joints for utility vehicles, lower door moldings, steering column covers and many more. Michel Lanoue, head the department of automotive and custom molding, summarize the current state of the industry as being tough, especially for suppliers that deal directly with OEMs. IPL deals only with suppliers, yet it still feels the cost pressures from above. Part of the secret to staying on top of the cost game is adding a safety margin on prices right from the get go, says director Lanoue. Holding good long-term contracts with most of its suppliers and staying on the leading edge is assuring IPL's success in the ever-growing cost reduction battle. Part of this company's innovation stems from advanced connectivity tools that it has been implementing. Presently it possesses EDI, ANX, CAD, reverse auctions and a rudimentary form of collaborative design to communicate with its clients and a few suppliers. Despite the fact that many connectivity tools exist there is a major lack of standardization between the various software and hardware protocols. There is also a major lack of confidence and trust that prohibits good human interactions from taking place. Relationships are being compromised by computers and extreme cost pressures. Covisint, created by the GM, FORD and Chrysler, offers promising new standardized connectivity tools that could create a solution to part of the dilemma. They claim to be able to improve collaborative design, the supply chain and e-procurement (reverse auctions), which would altogether greatly reduce costs. But

first trust and confidence have to resurface and only then perhaps can connectivity tools, such as Covisint, help reduce costs to all parties using it. For now, IPL believes it has already invested enough in a field that has not yet proven to be that cost effective.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | **+1** | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | **-1** | 0 | **+1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.10 : Automotive industry edge connection matrix, from IPL's point of view**

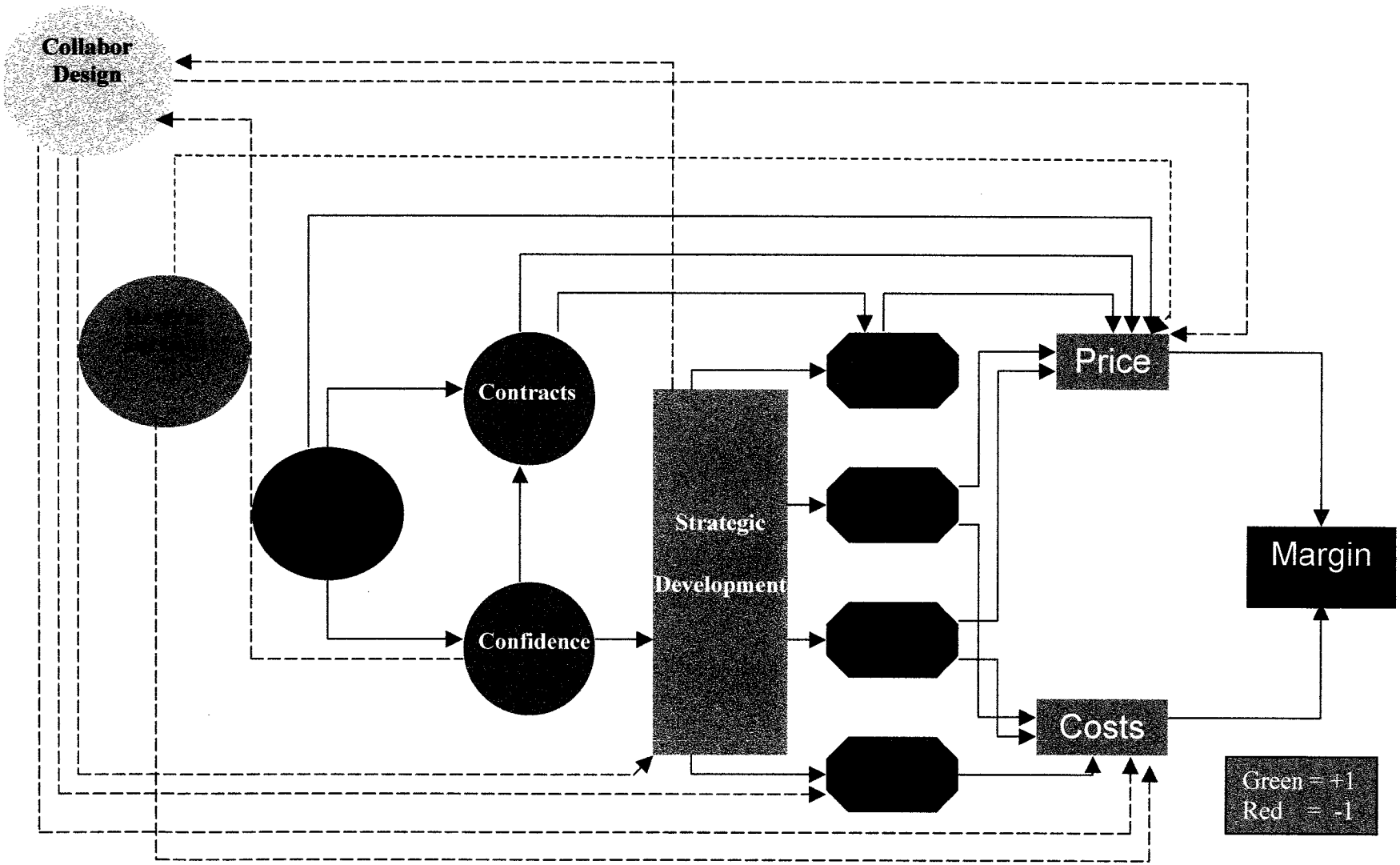



**Figure 4.10 : Current state of the automotive industry from IPL's point of view**

## Ispat International

*Ispat International –Isabelle Lemay – summary October 2nd, 2003.*

Ispat International is the world's seventh-largest steelmaker with annual capacity of more than 12.5 million tons and $4.5 billion in annual revenues. It was founded in 1976 by a Indian business man named Lakshmi N. Mittal. They service suppliers and OEMs across the globe with a wide array of products. Isabelle Lemay, IT manager at Ispat Montreal location, explains that in the steal industry competition is fierce, so much so, that many producers are forced to exit the market or face consolidation from major players. In such difficult times miss Lemay says it is very important to set yourself apart from the competition while staying well diversified. Ispat does so by setting customer quality and satisfaction standards above and beyond the competition. Maintaining good relationships with happy clients and suppliers keep Ispat in the lead. This day and age technology plays a key role in simplifying certain aspects of relationships. This steelmaker has been using many new connectivity tools such as EDI, XML, CAD, reverse auctions (sponsored by E-steel) to communicate with its clients and a few suppliers. Ispat even tried pushing a connectivity supply chain tool helping process orders and billing called E-steel. Howerver Ispat firmly believes that regardless of how well technology helps simplify communication channels it will never be as effective as human contact. With the lack of standardization that exists between the various software and hardware protocols connectivity is far from perfect. Technology brings good but also bad to this era. Since the creation of certain tools such as reverse auctions there is a major lack of confidence and trust that prohibits good human interactions from taking place. It seems that the combined pressure of cost reductions and imposed unwanted technological tools creates a barrier obstructing good human dealings. Due in part to the major technological crash

many OEMS and big suppliers, that had invested huge amounts of funds towards connectivity tools, are now forcing the rest of the market to follow in there footsteps. They may claim to be able to improve collaborative design, the supply chain and e-procurement (reverse auctions), which would altogether greatly reduce costs. But rushing and pushing such standards onto other players has only worsened the current state of events. Ispat remains attentive to the potential benefits that connectivity has to offer but keeps the focus on keeping its clients happy.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | **+1** | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | **+1** | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **+1** | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | **-1** | 0 | **+1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.11 : Automotive industry edge connection matrix, from ISPAT's point of view**

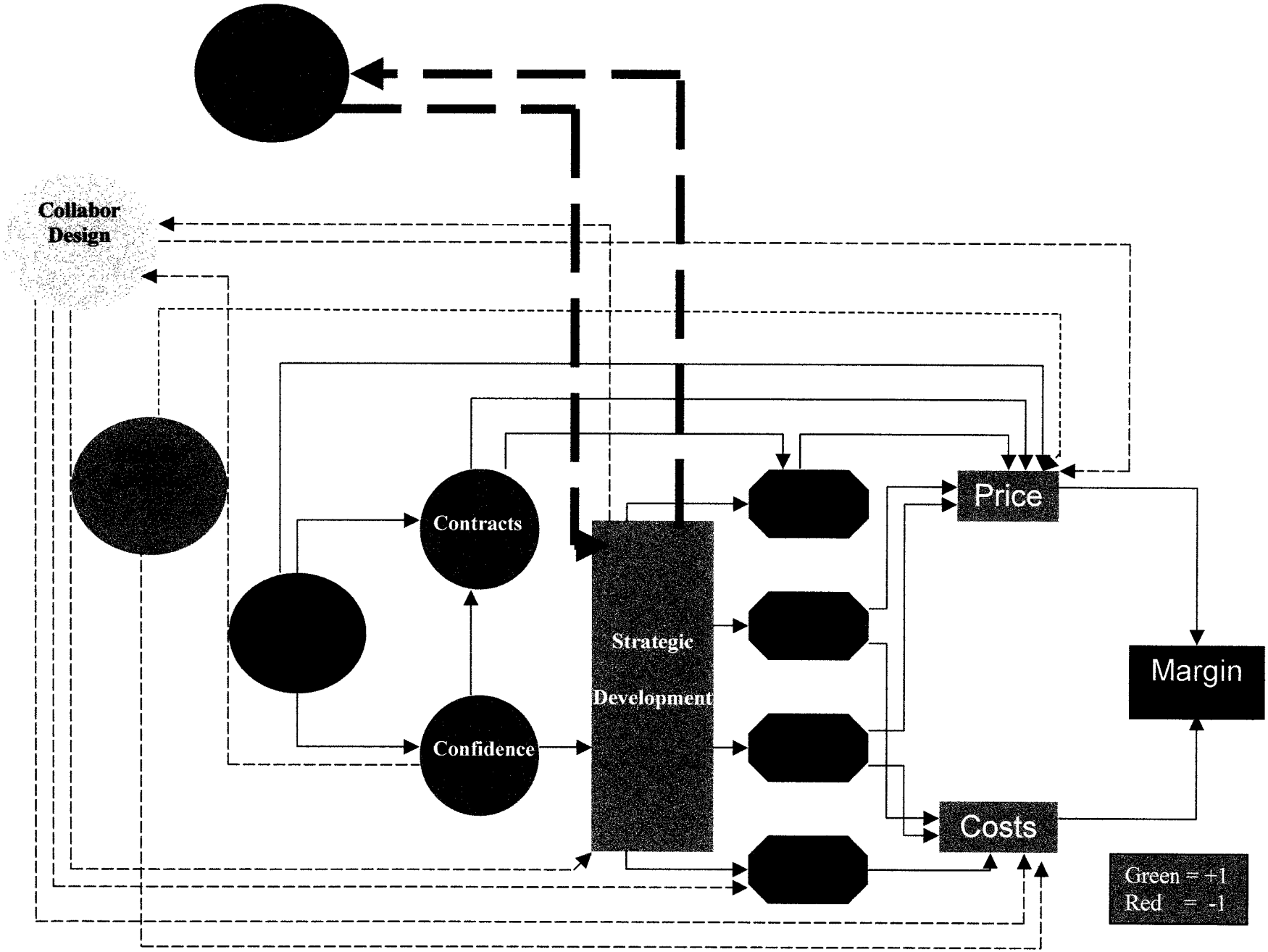



**Figure 4.11 : Current state of the automotive industry from ISPAT's point of view**

## ITW Deltar Canada

*ITW Deltar Canada – Steve Caldwell– interview summary September 24th, 2001.*

ITW Deltar Canada is a division of the worldwide Fortune 200 Company of Illinois Tool Works. Deltar has been a North American manufacturer of thermoplastic injection molded components and assemblies since its incorporation in July 1959. ITW as a whole has over six hundred divisions, 55000 employees and 10 billion dollars in sales in 43 countries. Strictly from the automotive side, ITW has sales of around 2.3 billion dollars and also a world presence. This big supplier is doing quite well, considering the current climate that is clouding the industry. Steve Caldwell, the sales manager in charge of the automotive industry, says costs are being pushed down onto them (suppliers) and trust and loyalty have left the building. Even so, ITW Deltar limited refuses to sacrifice its partnerships and good human relationships to save on cost. Human relations are key elements to any good business relations explains Mr. Caldwell. With the new era of telecommunication, new forms of technologies are emerging and changing the way relationships take place. ITW presently uses various tools such as EDI and CAD systems to communicate with its clients and various suppliers. Though many connectivity tools exist there is a major lack of standardization between the various manufacturer/supplier tools. Covisint is a promising new standardized connectivity tool that ITW has been eying for some time now. It claims to be able to improve collaborative design, the supply chain and e-procurement (reverse auctions), which would altogether greatly reduce costs. At the present time ITW has good online collaborative design tools with many of its customers and suppliers therefore it has no immediate need for new collaborative tools. However the reverse auction side of Covisint looks promising, at least when little volume

highly priced supplies are concerned. On the other hand, it is unlikely to interest ITW from a long-term/high volume stand point, because it can be better taken care of through good old fashioned face to face relationships, admits ITW Deltar's sales manager. Although it believes in Covinsint's cost saving potentials, right now this supplier will remain watchful and continue studying Covisint for possible future implementations.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | **-1** | 0 | **+1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.12 : Automotive industry edge connection matrix, from ITW's point of view**

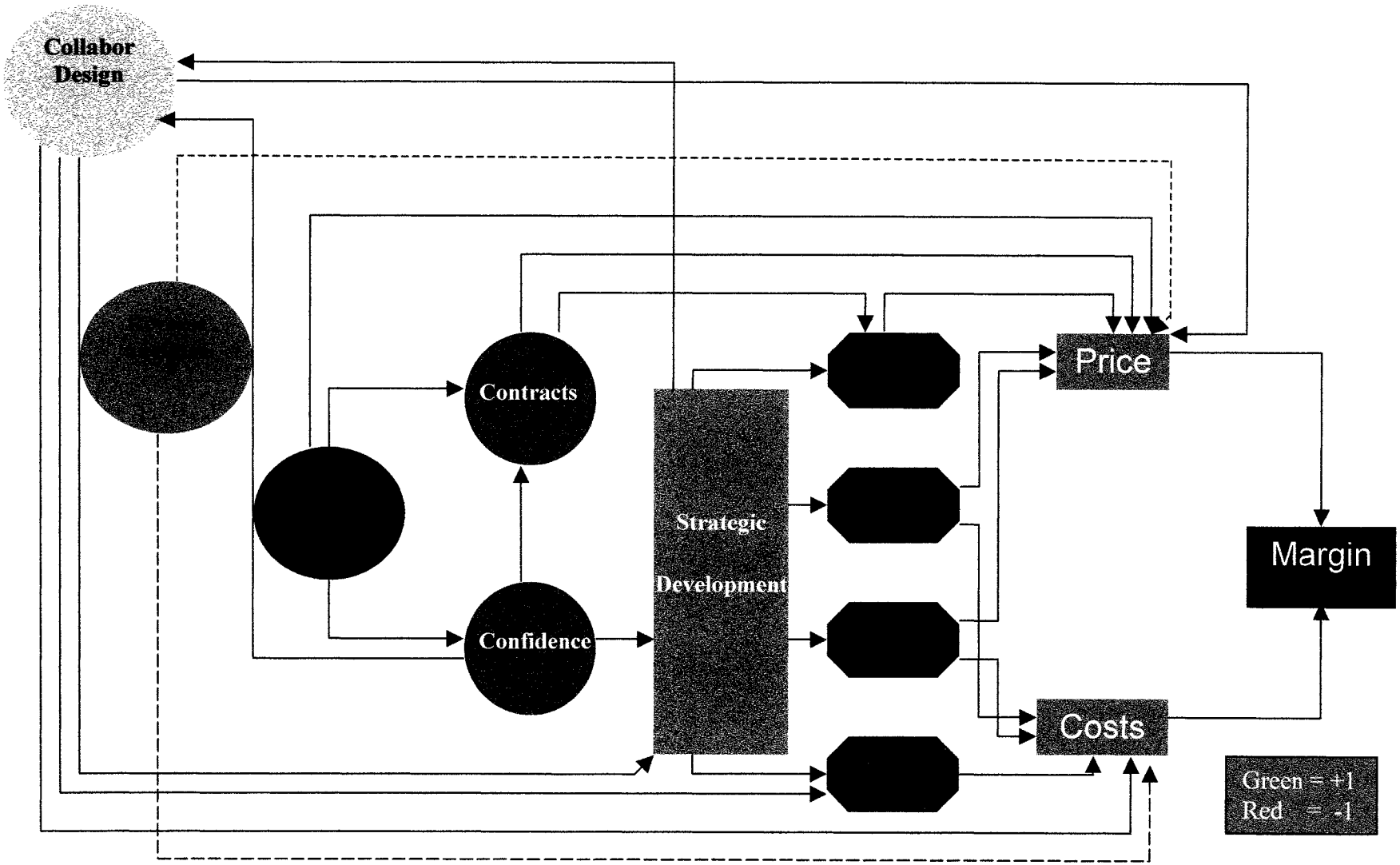



**Figure 4.12 : Current state of the automotive industry from ITW's point of view**

## LaGran Canada Incorporated

*LaGran Canada Incorporated – Robert Bélanger– interview summary October, 2001.*

LaGran was originally established in Granby (Québec) in 1931, under the name of Stark Bros Ribbon Corporation. Today the company evolved to LaGran Canada, a Canadian firm with its head office in Granby (Québec). It specializes in webbing for seat belts, for air bags (automotive), industrial webbing for slings, for safety harnesses as well as for parachutes (military). This specialized supplier feels the pressure of its clients and the clients OEMs that demand price cuts. Robert Bélanger, President at LaGran, says costs are impossible to ignore. When a company wishes to keep good ties with all its clients, it must adapt to their needs. Right now cost reduction is the buzz word that keeps all the bigger players happy. At LaGran, they have managed to survive by keeping superior quality standards, says monsieur Bélanger. While most big players are investing important sums of money on new forms of Internet technologies to save costs LaGran chooses to concentrate on human relationships. LaGran does have some basic Internet tools, such as EDI, to track supplies and to forecast future orders for its clients. However it sees no need for added tools to further help reduce costs. According to them cost reduction is not done through better connectivity but rather through better textile and labour control. It had never herd of Covisint or reverse auctions prior to the interview with CIRP. It believes new connectivity tools to be profitable for big suppliers and OEMS but sees very little use for them with LaGran. At LaGran, their primary objective is to satisfy their clients. They accomplish this by getting actively involved in their problem solving processes and by supplying them with products of superior quality.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | 0 | **+1** | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **+1** | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.13 : Automotive industry edge connection matrix, from LaGran's point of view**

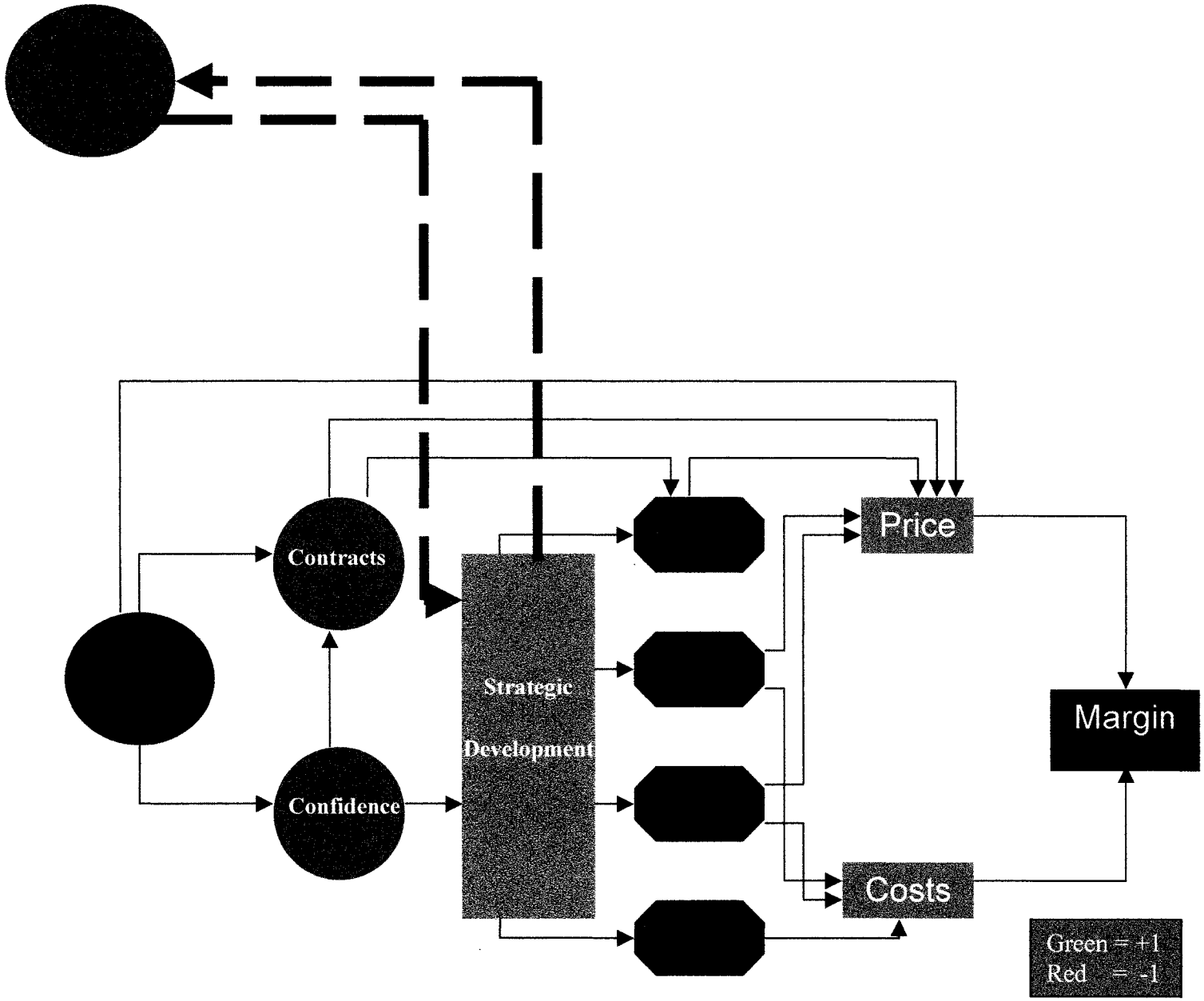



**Figure 4.13 : Current state of the automotive industry from LaGran's point of view**

## Montupet

*Montupet – André Visochis – interview summary October 2, 2001*

Montupet is a French owned company founded in 1894. It supplies aluminum car motor parts for many automotive manufacturers (GM, Ford, Renault, ...). It employs over 4000 people worldwide and makes revenues of 600 million dollars a year. André Visochis, technical director of Montupet's Canadian branch, feels that the climate in the automotive industry is very hostile at the present time, especially towards car suppliers. Manufacturers demand capacity quotas from their suppliers at extremely low prices. In order to survive, most suppliers have no choice but to accept and provide the product according to the wanted demand. Visochis states that the problem arises from the fact that the manufacturer never ends up ordering the requested amounts. Big players, such as GM and Ford, have supply predictions that are always overestimated and the supplier ends up paying for it. Having very few clients, with whom very long-term contracts have been signed, puts the supplier at their mercy. Every manufacturer uses unique standards and equipment with which the supplier must comply to. The few universal standards that all car manufacturing industries share, such as EDI, are not properly utilized, which greatly compromises orders and deliveries. Manufacturers strongly advise their suppliers to invest into an Internet-like technology, created for the automotive industry, named ANX (American Network Exchange). They impose, however, a standard that they do not even follow themselves. Montupet deals with GM Power Train , which is a subdivision of GM that does not dispose of any internet technologies and is reluctant to integrate them to its existing systems. With an initial setup fee of 200 to 300 hundred thousand dollars, plus annual fees of 100 000$, suppliers cannot afford to invest in a technology that is not commonly used or tailored to their needs. In order to become profitable, Internet based

technologies need to be fully integrated and standardized throughout the entire automotive industry. Unfortunately, because of security concerns, potential users are apprehensive to switching to such a technology. Until someone sets the norm and demonstrates the benefits of integrating IT into the current work environment, it has no chance of being implemented and standardized any time soon. With the just in time standard that is being used, and the major problems and lack of standardization that suppliers face, it is hard to remain efficient and profitable.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.14 : Automotive industry edge connection matrix, from Montupet's point of view**

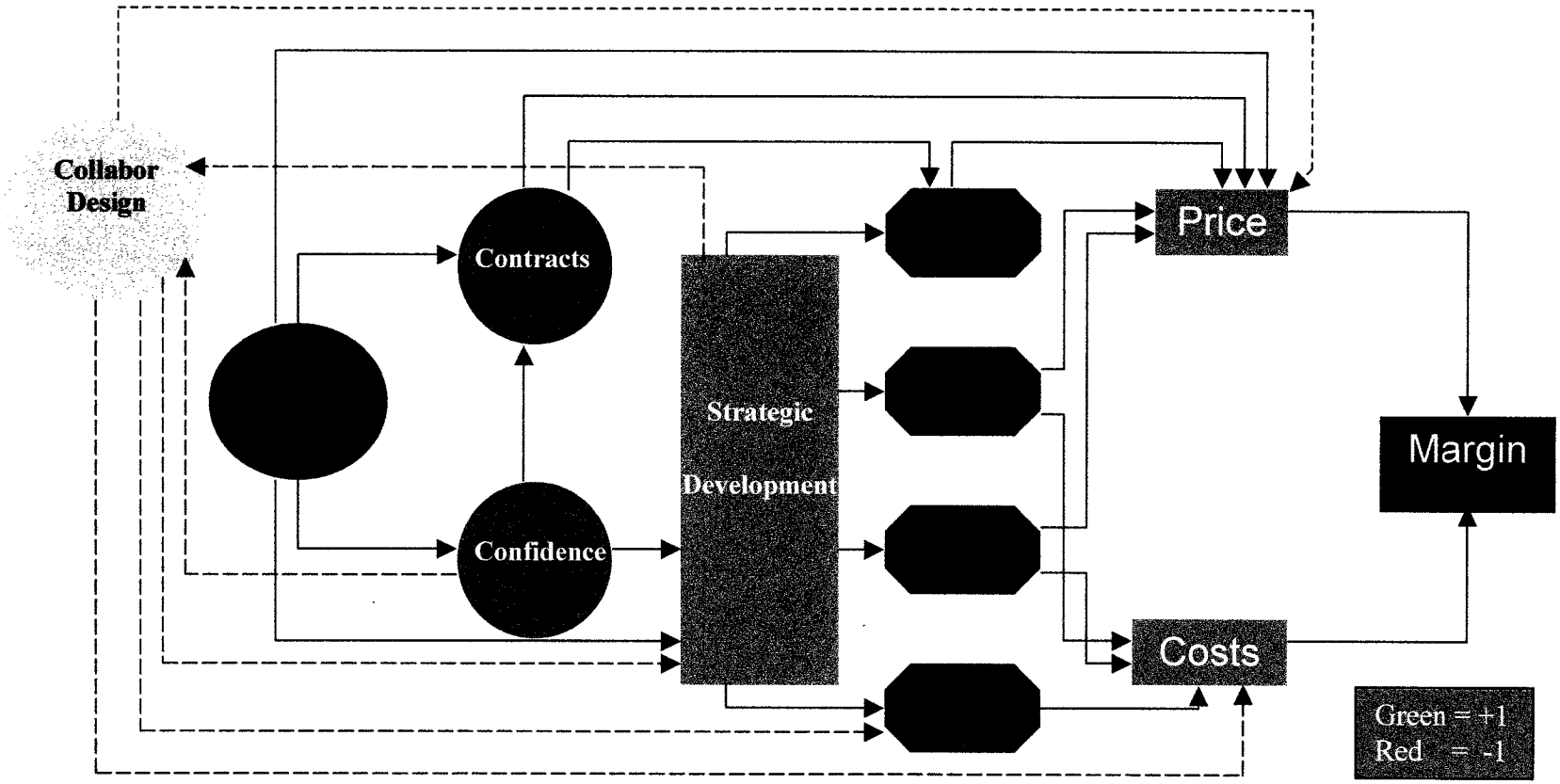



**Figure 4.14 : Current state of the automotive industry from Montupet's point of view**

## Ramsden Industry Ltd

*Ramsden Industry Ltd – Bob Ramsden – interview summary October , 2001.*

Ramsden Industry Limited is an aluminium mold-casting company that has been around since 1946.Ramsden is a small supplier serving around 40 companies from around Canada and the United States. Only half a dozen originate from the automotive companies so Ramsden has very little involvement in this sector. When its president, Bob Ramsden, was questioned in regards to the current cost pressures that suppliers are being imposed, he simply said it was of no concern to his company. "We are just a small player", he responded. The president was then asked his opinion regarding connectivity issues concerning Ramsden, its client and its suppliers. He responded by saying Ramsden had very limited connectivity links with its customers and suppliers. Ramsden has EDI capabilities but they are very limited. Covisint was a totally new concept for the president and he saw little use for it in his company. The only connectivity tool he showed some interest in was the reverse auctions. He believed such a tool could have potential benefits for Ramsden some time in the near future. All in all Ramsden is a very small player with little concern regarding the bigger fish in the automotive sea.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | **0** | 0 | 0 | 0 | **0** | **0** | 0 | 0 | 0 | **0** | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | 0 | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | **-1** | 0 | **+1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.15 : Automotive industry edge connection matrix, from Ramsden's point of view**

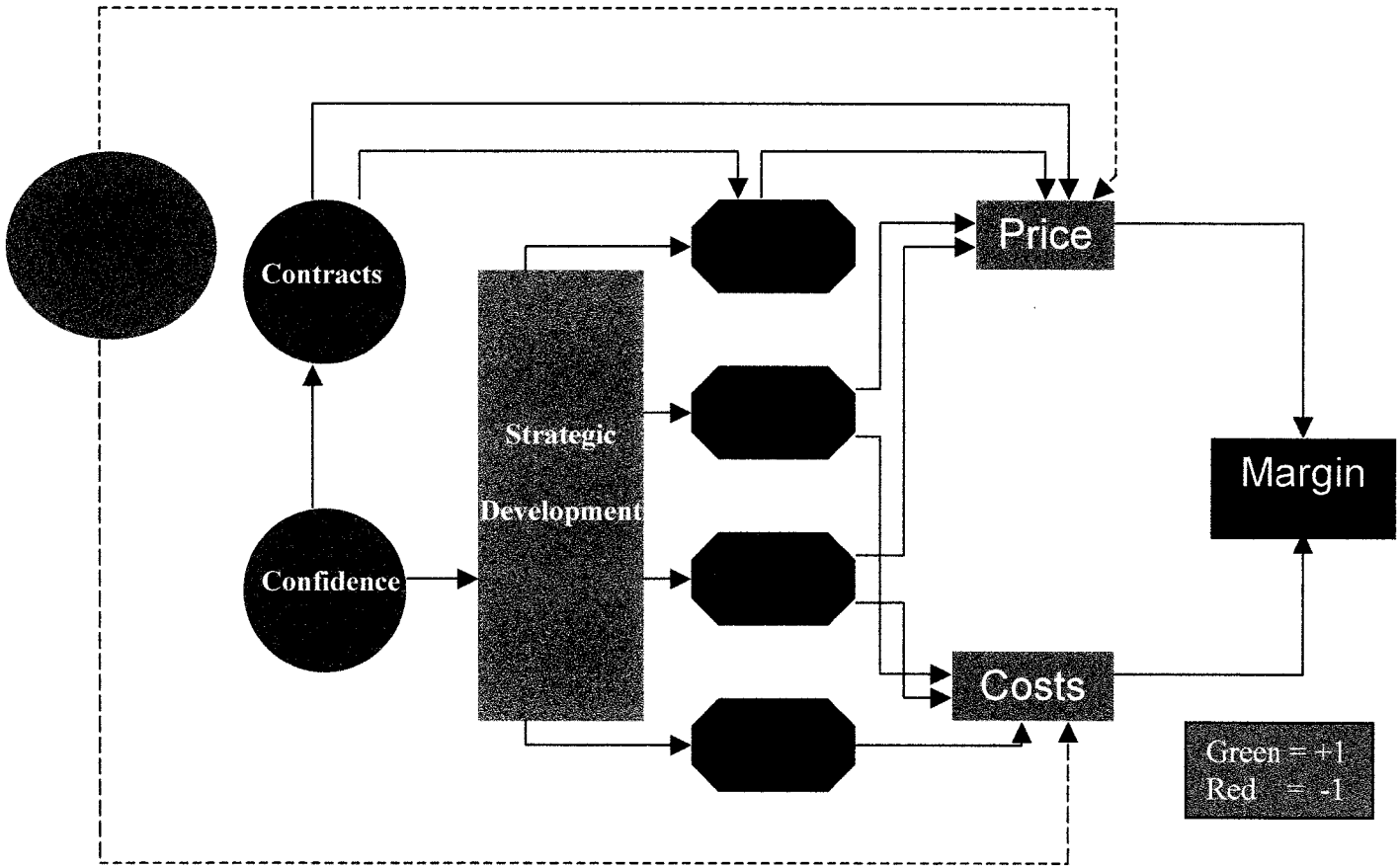



**Figure 4.15 : Current state of the automotive industry from Ramsden's point of view**

## The Woodbridge Group

*The Woodbridge Group – Carol Dickson – interview summary September, 2001.*

The Woodbridge Group is a leader in automotive urethane technologies and a specialist in just-in-time assembly and sequencing systems. Woodbridge's experience in producing polyurethane foam products dates back to the early 1960's. With over 50 facilities, spread over 14 countries around the globe, Woodbridge is considered a big player in the supply industry. Approximately 98% of the company specializes in the automotive sector while the other 2% is diversified in other fields. Carol Dickson, VP of business development and Systems Integration, explains that because Woodbridge is such a big player serving big clients it faces the competitive pressure of continued globalization. "The price of being a key supplier is you must be everywhere", says Miss Dickson. Added to this ordeal are the tremendous cost pressures that are being applied downwards from OEMs. Margins a very thin but suppliers have no choice but to support this kind of unprofitable growth. Woodbridge can say no to one of its customers, if it is asking too big a sacrifice, but it will very rarely do so. This polyurethane leader uses practical techniques to keep its costs to a minimum. Electronic connectivity tools are one way to help out in this matter. Woodbridge has invested wisely in different connectivity technologies, such as EDI, ANX, collaborative design CAD tools via the net as well as via fax. However a lack of standardization inhibits major collaborations to take place. Covisint, founded by Ford, Chrysler and GM, brings forth new high-speed connectivity tools that could become an industry standard. For the time being they are operational only for reverse auction set-ups but new options, such as collaborative designing and supply management, are continuously being added. Many suppliers, including Woodbridge, remain sceptical to

the benefits of such a tool, especially after having seen the pitfalls of participating in reversion auctions. Furthermore the question miss Dickson asks herself is, who really profits from this new standard? It presently seems to be just the OEMs. How can one have confidence and trust in a system that is only benefiting the big car monopolies? Covisint has great potential that could bring prosperity for all in the industry, but presently it is being misused. Instead of bringing solutions it is destroying already unstable relationships. Bottom line says Carol Dickson, "If connectivity helps us serve a few of our customers better at lower costs, Woodbridge is all for it. If it adds complexity and more costs and actually causes interference in our business, we are not for it." Only time will tell.

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | **+1** | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | **-1** | 0 | **+1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.16 : Automotive industry edge connection matrix, from Woodbridge's point of view**

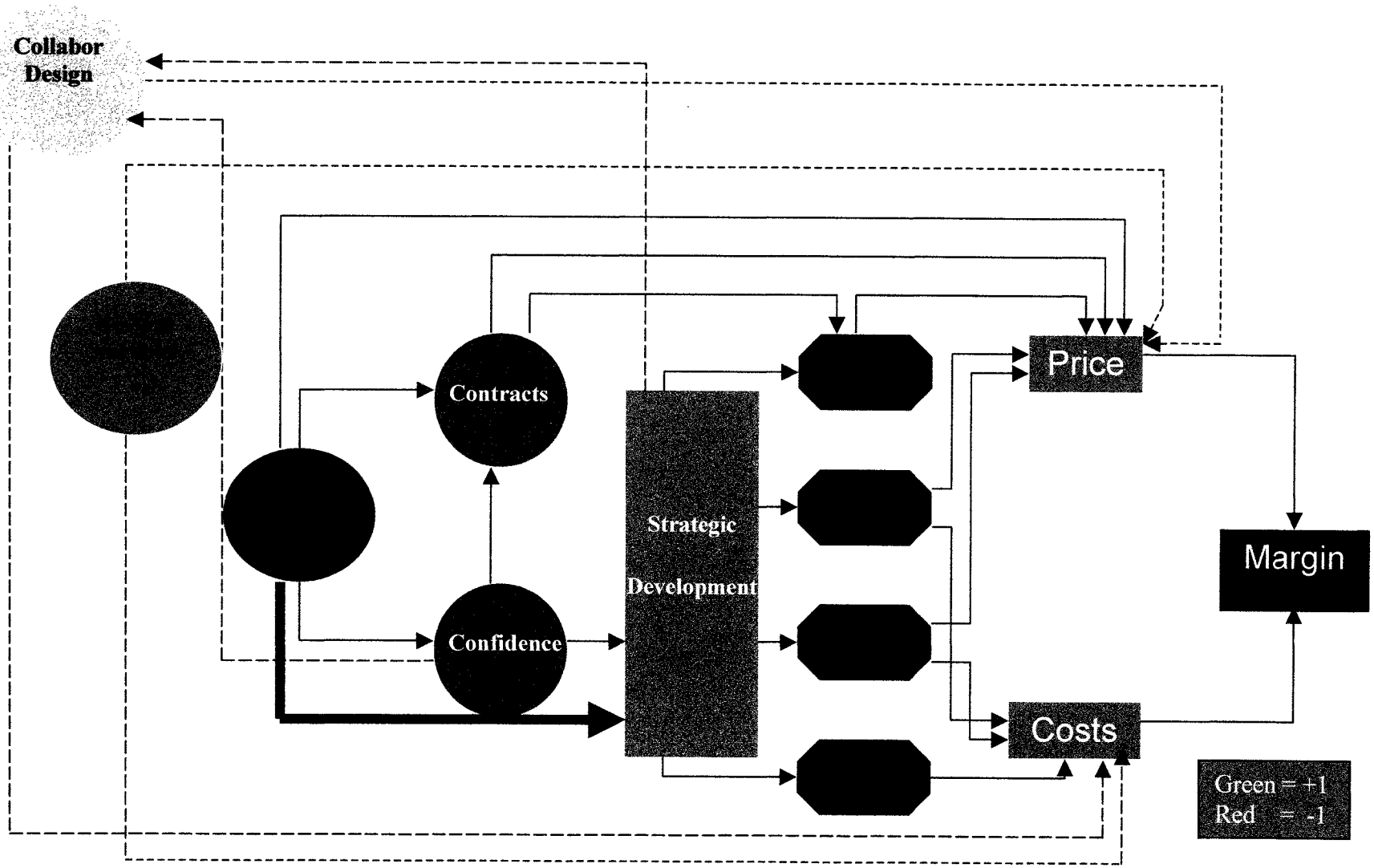



**Figure 4.16 : Current state of the automotive industry from Woodbridge's point of view**

## Tyco Electronics

*Tyco Electronics – Sam Alesio – interview summary September 26th, 2001.*

Tyco Electronics offers a broad range of high quality electronic component products to many suppliers and OEMs around the world. Roughly 25% of the company specializes in the automotive sector selling passive component (connectors, relays, circuit breakers...). The other 75% of Tyco is involved in communications and the computer sector. Sam Alesio, business unit manager of the motor vehicles division, explains that because Tyco is a well rounded company with global diversity, it manages to remain ahead of the car industry crash that so many are suffering. There is tremendous pressure being applied downwards to various suppliers so one must diversify the risk over many OEMs. Tyco is a big enough player to say no to one of its customers, if it is asking too big a sacrifice. Price cuts have to be beneficial to both side for Tyco to show cooperation, admits MR. Alesio. This electronics giant uses many forms of proactive techniques to keep its costs to a minimum. Internet connectivity tools is said to be one promising avenue to do so. For this purpose, Tyco has invested wisely in different connectivity technologies, such as EDI, collaborative design CAD tools via the net, as well as autonomous fax capabilities and an on-line catalogue. Not all customers and suppliers are ready for high speed Internet connectivity and that is why Tyco uses old as well as new forms of communication technologies (ex: fax and the web). Nevertheless, by being in the electronics business, Tyco is aware of the need to continuously keep updating technology in order to remain competitive and at the top. Unfortunately, not all tools offer positive results. Tyco has participated in many reverse auctions organized by Covinsint and realized they only seem to help eliminate profits from all its participants. In such aspects,

connectivity destroys relationships instead of solidifying or creating them. Even without considering human relationships Mr. Alesio admits that from his point of view if it does not increase sales or reduce costs, why do it? Many free Internet tools similar to Covisint already exist so why pay for it when only OEMs seem to be its sole benefactors?

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | **+1** | 0 | 0 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | **+1** | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | **+1** | 0 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | **-1** | 0 | **-1** | 0 | 0 | 0 | 0 | 0 | **+1** | **+1** | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 4.17 : Automotive industry edge connection matrix, from Tyco Electronics point of view**

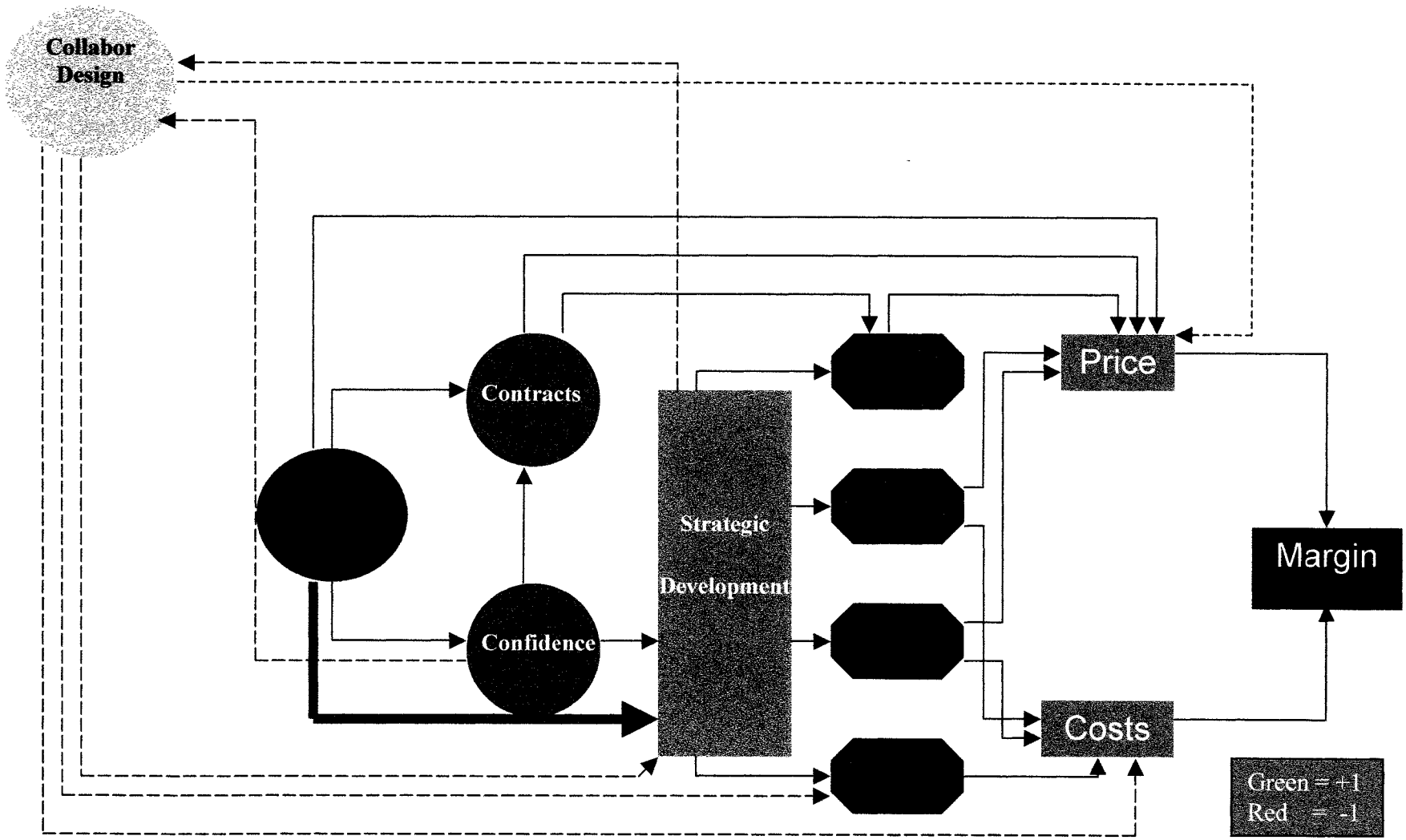



**Figure 4.17 : Current state of the automotive industry from Tyco Electronics point of view**

# Chapter 5

# Analysis of the 17 interviews

## 5.1 Vector multiplication reactions

The first step that was taken during the analysis phase was a visual inspection of the 17 edge connection matrices. Due to the many similarities found among them, it was determined that a "compounded matrix" would be created out of the 17. The compounded matrix "A" represents the qualitative "collective wisdom" of the interviewed persons. The interviews were conducted in a rather unstructured format with equally qualified (non qualified) individuals on an emergent topic (where there is not too much past experience). We retained only qualitative simply majority vote style aspects of the set of interviews. In our opinion this qualitative approach makes sense in this case because it is rather difficult to quantify the causality between the subjective notions involved in interviews.

To create the compounded matrix "A" we added all corresponding concept causality values from each individual (company specific) edge connection (correlation) matrix together. If the sum of each concept calculated was positive, the final normalized value for that concept became +1. If the sum of each concept calculated was negative the final normalized causality value for that concept became –1 and, finally, if the sum was 0 then

the answer remains 0. In other words, if we take the price concept for the sake of example and add all 17 price causality values, we would obtain +17 (1+1+1+1+1…+1 = +17). Since the answer is positive 17 then we know the normalized price causality value for our compound matrix will be +1. The following page contains the normalized compounded matrix of the 17 interviews (for more details concerning calculations see *Appendix B*).

| | 1)Price | 2)Margin | 3)Costs | 4)Drastic price drop | 5)Contracts | 6)Confidence | 7)Volume | 8)Innovation | 9) Continuous improvement | 10) Strategic development | 11) Services | 12) Collaborative design | 13) Supply chain | 14) Reverse auction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1)Price | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2) Margin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3)Costs | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4)Drastic price drop | +1 | 0 | 0 | 0 | +1 | -1 | 0 | 0 | 0 | +1 | 0 | +1 | 0 | 0 |
| 5)Contracts | -1 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | 0 |
| 6)Confidence | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 | +1 | 0 | +1 | 0 | 0 |
| 7)Volume | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8)Innovation | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9) Continuous improvement | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10) Strategic development | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | 0 | +1 | +1 | +1 | 0 |
| 11) Services | +1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12) Collaborative design | -1 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | +1 | +1 | 0 | 0 | 0 | 0 |
| 13) Supply Chain | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | +1 | 0 | 0 | 0 | 0 |
| 14) Reverse auctions | -1 | 0 | +1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Table 5.1: Automotive industry compounded edge connection matrix "A"**

**The normalized matrix A can also be represented as follows**

A=

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | -1 | 0 | 0 | 0 | -1 | 0 | 1 | 0 | 0 |
| -1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| -1 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| -1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The compounded matrix gives an approximate ("fuzzy") picture, not an exact picture, of the manufacturer/supplier relationships according to the 17 suppliers that were interviewed.

Once the compounded matrix was completed, we then proceeded to testing the vector multiplication scenarios in order to achieve results concerning connectivity issues between suppliers and manufacturers. In order to better understand and interpret the following results, it is important to revisit chapter 2 of this thesis.

As previously mentioned, out of the fourteen concepts that are seen in each suppliers matrix, only the last three (collaborative design, supply chain and reverse auctions) are of concern for this study, since they focus on Internet based tools. To test the FCM dynamical systems, we will multiply our new compound matrix "A" by seven possible "firing/activation" combinations of these three concepts.

The thresholding assures that both state vector instances C(k) and C (k+1) are consistently defined over the same binary domain {0, 1}, despite the fact that the matrix multiplication may generate results over a larger domain.

The subsequent "normalization" procedure of the resulting state vector C, after each matrix multiplication iteration, consists of: (i) reinforcing the "1" value indicating the persistence of the activity of the initially "fired/activated" conceptual node(s).

The dynamic process described by the iterative FCM can have three possible outcomes. If the normalized vector C(k+1) is identical with the previous normalized vector C(k), it means that the FCM dynamical system has reached a "fixed-point attractor" and therefore the matrix multiplication iteration finally halts. In other cases it may happen that the FCM keeps cycling through a fixed path of states, known as the "limit cycle". Finally, in the third case the iterative FCM process indefinitely keeps producing random state vector values, also known as the "chaotic attractor" [Mohr 2003].

This whole procedure can be done with a simple piece of paper and pen but would take many long hours to achieve. A MTALAB program was therefore created to generate these results. The following paragraphs and pages will provide us with a brief overview of the seven firing vector scenarios, as well as the corresponding normalized results and their interpretations. (For a more in-depth look see Appendix B for detailed program code and matrix results)

## Scenario 1: Reverse auction node is activated.

C1 = [0 0 0 0 0 0 0 0 0 0 0 0 0 1] * [A]

**Result:**

Normalized C3 matrix achieves a **fixed point attractor**

C3 = [0 0 1 0 0 0 0 0 0 0 0 0 0 1]

According to this result, when the reverse auction node is active, cost is also positively correlated (increasing) but all other nodes remain unaffected.

**Interpretation for the industry:**

These results concord with the general feeling suppliers have been expressing in regards to the high costs of implementation concerning reverse auctions. Therefore, if these results were shared with suppliers they would most likely not invest in such connectivity tools.

**Compared to real supplier responses:**

Although cost would go up, it is not the only plausible affected node. As seen in the 17 FCMs and edge connection matrices, price is the other concept that would most likely be affected.

**Scenario 2: Supply chain node is activated.**

C1 = [0 0 0 0 0 0 0 0 0 0 0 0 1 0] * [A]

**Result:**

Normalized C4 matrix achieves a **fixed-point attractor**

C4 = [0 0 0 0 0 0 1 1 1 1 1 1 1 0]

According to this result when the supply chain node is active volume, innovation, continuous improvement, strategic development, service and collaborative design are also positively correlated (increasing) but all other nodes remain unaffected.

**Interpretation of the industry:**

These results would be somewhat surprising to the eyes of most suppliers since they only expect Internet based connectivity tools to further increase their costs. They generally did not give any consideration to the possible benefits such tools could generate. Consequently, if these findings are presented to the industry they might help OEMs sell their e-business apparatus by convincing suppliers of the potential benefits that can result from their usage.

**Compared to real supplier responses:**

It is plausible to hypothesize that supply chain improvements can help create an increase in volume, innovation, continuous improvement, strategic development, service and collaborative design. If a better supply chain exists volume will increase which generates more funds for investments towards the other concepts. However, too few data were available (too little interview feedback) to give an accurate and reliable answer regarding supply chain management.

**Scenario 3: Supply chain and reverse auction nodes are activated.**

C1 = [0 0 0 0 0 0 0 0 0 0 0 0 1 1] * [A]

**Result:**

Normalized C4 matrix achieves a **fixed-point attractor**

C4 = [0 0 1 0 0 0 1 1 1 1 1 1 1 1]

According to this result, when the supply chain and reverse auction nodes are activated, cost, volume, innovation, continuous improvement, strategic development, service and collaborative design are also active (increasing) but all other nodes remain unaffected.

**Interpretation of the industry:**

Once again these results would be somewhat surprising for most suppliers since they only expect Internet based connectivity tools to further increase their costs. They generally did not give any consideration to the possible benefits such tools could generate for their company. Consequently, if these findings are presented to the industry they might help OEMs sell their e-business tools even though costs will increase when implementing them.

**Compared to real supplier responses:**

Supply chain and reverse auctions have not both been assessed simultaneously by suppliers during interview questioning. Most of the interviews talked about reverse auctions and expressed cost increases but very few had implemented Internet supply chain tools.

**Scenario 4: Collaborative design node is activated.**

C1 = [0 0 0 0 0 0 0 0 0 0 0 1 0 0] * [A]

**Result:**

Normalized C4 matrix achieves a **fixed-point attractor**

C4 = [0 0 0 0 0 0 1 1 1 1 1 1 1 0]

According to this result, when the collaborative design node is activated, volume, innovation, continuous improvement, strategic development, service and the supply chain are also active but all other nodes remain unaffected.

**Interpretation of the industry:**

Collaborative design is a tool that would greatly help re-establish some of the lost relationships that have occurred in the industry. Manufacturers and suppliers would learn to re-trust each other in order to work together. Collaborative design would help increase volume, innovation, continuous improvement, strategic development, service and the supply chain since it promotes manufacturer and supplier team work. It's a win win situation if manufacturers make an effort to promote better relations with their suppliers.

**Compared to real supplier responses:**

According to the FCM interview results, price and cost were the two concepts being negatively affected by collaborative design. None of these results have surfaced from the above C4 normalized matrix. However, according to some of the supplier interviews, strategic development and continuous improvement can have positive correlations with collaborative design.

**Scenario 5: Collaborative design and reverse auction nodes are activated.**

C1 = [0 0 0 0 0 0 0 0 0 0 0 1 0 1] * [A]

**Result:**

Normalized C5 matrix achieves a **fixed-point attractor**

C5 = [0 0 1 0 0 0 1 1 1 1 1 1 1 1]

According to this result, when the collaborative design and the reverse auction nodes are activated, cost, volume, innovation, continuous improvement, strategic development, services and the supply chain are also active (increasing) but all other nodes remain unaffected.

**Interpretation of the industry:**

These result are not surprising since as we have seen in some of the other generated scenarios, collaborative design tends to increase volume, innovation, continuous improvement, strategic development, services, the supply chain, where as, reverse auctions tend to increase costs. It would therefore seem logical to assume that by simultaneously activating both concepts the generated results would be a combination of both types of results found on an individual basis. Therefore, suppliers would probably opt for implementing only collaborative design in order to keep cost increases to a minimum.

**Compared to real supplier responses:**

Collaborative design and reverse auctions have not both been assessed simultaneously by suppliers during interview questioning. Most of the interviews talked about reverse auctions and expressed cost increases but very few had implemented Internet collaborative design tools. Many had, however, expressed a profound interest in regards

to standardized collaborative design tools, which they believed could improve innovation, continuous improvement and strategic development, among other things. This indicates many similarities to the above results but still leaves volume, services and supply chain out of the picture. We can hypothesize that the common nodes that are affected both from the vector multiplication results and FCM edge connection matrices are more likely to be affected in a real life scenario, if collaborative design and reverse auctions are both simultaneously implemented.

**Scenario 6: Collaborative design and supply chain nodes are activated.**

C1 = [0 0 0 0 0 0 0 0 0 0 0 1 1 0] * [A]

**Result:**

Normalized C4 matrix achieves a **fixed-point attractor**

C4 = [0 0 0 0 0 0 1 1 1 1 1 1 1 0]

According to this result, when the collaborative design and the supply chain nodes are activated, volume, innovation, continuous improvement, strategic development and services are also active but all other nodes remain unaffected.

**Interpretation of the industry:**

Once again these result are not surprising since as we have seen in some of the other generated scenarios, both collaborative design and supply chain tend to increase volume, innovation, continuous improvement, strategic development and services. It would therefore seem logical to assume that by simultaneously activating both concepts the generated results would be a combination of both types of results found on an individual basis. This being said, suppliers should consider investing in both the connectivity tools that seem to bring out many added benefits without involving cost variations.

**Compared to real supplier responses:**

Collaborative design and supply chain Internet tools have not both been assessed simultaneously by suppliers during interview questioning. As mentioned in previous paragraphs, most of the interviews talked about the desire to get better collaborative design tools but practically no one mentioned anything in regards to the supply chain side of things.

**Scenario 7: Collaborative design, supply chain and reverse auction nodes are activated.**

C1 = [0 0 0 0 0 0 0 0 0 0 0 1 1 1] * [A]

**Result:**

Normalized C5 matrix achieves a **fixed-point attractor**

C5 = [0 0 1 0 0 0 1 1 1 1 1 1 1 1]

According to this result, when the collaborative design, the supply chain and the reverse auction nodes are activated, cost, volume, innovation, continuous improvement, strategic development and services are also active but all other nodes remain unaffected.

**Interpretation of the industry:**

A combined activation of all three e-business concepts generates results that contain both positive and negative outcomes. This is not very surprising, since the implementation of all three Internet technologies will without a doubt cost a lot but should eventually also increase company profitability. It would seem to indicate that it is better to implement these e-business solutions individually rather then simultaneously based on each tools possible future results.

**Compared to real supplier responses:**

Due to the very little number of suppliers already possessing all three mentioned Internet technologies, it is difficult to compare computed results to suppliers predicted results. Nevertheless, as it was mentioned above, it can be hypothesized that suppliers will not implement all three Internet technologies simultaneously, due to the heavy costs and the mixed results their combined implementations would generate.

## The big picture

By combining all sources of results, the qualitative ones through the interviews and the quantitative ones through the FCMs, we can come to some common, as well as some controversial, conclusions. The common conclusions tell us that the implementation of Internet connectivity will greatly increase costs as well as volumes, which tends to be really happening in the industry at the present time. Many suppliers are either shutting down, due to many losses, or merging with bigger companies to assure their survival. This is in great part due to those increases in costs that end up annihilating all possibilities of profits. Volumes are going up, due to the fact that the suppliers that managed to survive had to produce additional quantities to compensate for the lost output of failed companies. The controversial conclusions that where found by the various vector/matrix multiplication scenarios generally indicate that, by implementing new information technologies (collaborative improvements, supply chain...) innovation, continuous improvement, strategic development and services are generally activated as well. This is an interesting controversy because the interviewed suppliers made no mention of such possible results. Yet, if we look at other fields where Internet technologies have been brought forth, such results have often surfaced. Take banking for example, services, strategic development, innovation have all been greatly influenced by the Internet tool revolution. Fewer tellers are needed and less paper documents are required since many people now due their banking online. These factors and many more save banks millions of dollars per year. Many other industries have obtained the same kind of results, which brings us to the hypothesis that they are also possible in the automotive industry.

# Chapter 6

# Conclusions

This thesis began by introducing its readers to the creation of Internet followed by a guided tour of the various decision support system tools (DSS) that are currently available there, helping facilitate human decision-making. Each one's strengths and weaknesses were described. Fuzzy Cognitive Maps (FCMs) were then introduced, as a valuable DSS tool, and the reason was given why this expert system was chosen for the purpose of this study. We then proceeded to describing the complex automotive world. This permitted the readers to better understand the various relationships and power plays that surround the car industry. Once the key concepts were introduced, 17 interviews with leading car suppliers were considered. It was then time to proceed to a detailed summarization of each of the interviews, followed by a detailed FCM and edge connection matrix accompanying each one. This completed the qualitative part of the study. In order to go on to the quantitative part of the thesis, a vector multiplication program that permitted us to extrapolate quantitative results out of the qualitative data was created. Finally the data were analyzed and conclusions where drawn to determine how connectivity impacts car supplier/manufacturer relationships.

The North American automotive suppliers, in association with information technologies, are found to sidestep or totally ignore this potential e-business solution. This is due to the

current state of affairs in this complex environment. As previously mentioned, drastic price drops, lack of trust, security concerns and manufacturer monopolies are some of the top concerns at the time the interviews took place. Even though some automotive specialists claim that Internet connectivity tools could save suppliers up to a 1000$ per car, this is far from being taken seriously by the car industry [Navarre 2003]. The normalized generated vector/matrix scenario results also show promising possibilities, such as increases in volume, innovation, continuous improvements, strategic development and services. However, the fact remains that before bringing in the new, one must first throw out the old. As long as past issues and conflicts remain, many unresolved potentially future opportunities will remain put-aside and ignored.

Like many other decision analysis tools, Fuzzy Cognitive Maps help us assess complex situations that would otherwise be very time consuming and perhaps very costly to determine. Unfortunately, all these tools remain vulnerable to human interpretation. To ascertain the validity of a fuzzy cognitive map we would have to compare the outcome of the simulations with the actual effect of the event being modeled. If the fuzzy cognitive map, as it is, does not prove good enough to predict the behaviour of the actual system that is being modeled, then it would be necessary to fine tune the model. The fine-tuning of the fuzzy map can be done by adding more factors, by rearranging the causality relationships or by modifying the intensities of effect.

The fact that this study was conducted using a very limited amount of "semi-structured" data (17 "fuzzy" interviews), greatly limits the validity and accuracy of the simulated FCM results. Judging by the answers on the previous pages, even though we have found stability in every tested scenario (fixed point attractors), it is hard to draw black and white conclusions. More structured questions and answers are needed over a much wider array of participants. This being said, it is also important to remember that, in every day life, many decisions must be made fast, with often little data and facts. These circumstances are clearly illustrated in this thesis allowing one to ascertain the great power and flexibility that FCMs can bring to today's busy fast paced life.

As was proven in this thesis, this powerful adaptive expert system is a very versatile tool. We applied it to the automotive industry but many other fields could profit from it. The intelligence field comes to mind, for it is involved in data collection, analysis and reporting to prevent major threats to national security. It is faced with many complex scenarios that continuously change and evolve. With today's growing threats, these agencies must react very quickly and make decisions that often require more time than is provided. FCMs, if properly used, could help counter some of these threats by generating a multitude of possible scenarios in a fraction of the time. All in all, this tool is a helpful attribute to human decision analysis that can be applied to a variety of sectors and circumstances to better serve the world.

# REFERENCES


[Bottorff 2000] Bottorff, W. W., "A Quick History of the Automobile for Young People", http://www.ausbcomp.com/~bbott/cars/carhist.htm.

[Chaib 1998] CHAIB-DRAA, B. et al, "A rational model of cognitve maps", Département d'Informatique, Faculté des sciences, Université Laval, 1998.

[Doyle 1993] D.Doyle, "Expert Systems, Decision Support Systems and Computer-Assisted Instruction for Water Resource Management (II)" An Electronic Bibiography, http://www.nal.usda.gov/wqic/Bibliographies/eb9608.html, 1993

[Gondolf 2001] Gondolf, C, "Feedback on the Eighteen Semi-structured Interviews of Executive Heads of Canadian Suppliers of the Automotive Industry", CIRP, 2001.

[Hafner 1999] Hafner, V., "An introduction to Cognitive Maps", http://www.cogs.susx.ac.uk/lab/nlp/gazdar/teach/atc/1999/web/verenah/, 1999.

[Harbour 2002] The Harbour Report 2002, "Manufacturing Analysis Company by Company, Plant by plant", Harbour and Associates, Inc, 2002.

[Hillbrand 2002] C. A. Hillbrand and D. Karagiannis, "An Approach to Facilitate Complex Planning Issues by Means of Machine Learning Techniques Applied to Cybernetic Cause-and-Effect Models", Proceedings of the 6th World Multiconference on Systemics, Cybernetics and Informatics, 2002.

[Howard 1984] Howard, R. A., and Mathenson, J., "The Principles and Applications of Decision Analysis, 2, Strategic Decision Group, Menlo Park, California, 1984, pp. 719-762.

[Jackson 1998] Jackson, P., "Expert Systems", Addison-Wesley, 1998.

[Kaplan 1992] R. Kaplan and D. Norton., "The balanced scorecard: Measures that drive performance", Harvard Business Review, vol. 70, no. 1, January-February 1992, pp. 71-79.

[Kaplan 1996] R. Kaplan and D. Norton, "Using the balanced scorecard as a strategic management system", Harvard Business Review, vol. 74, No. 1, January-February 1996, pp. 75-85.

[Keller 1997] Keller, P. E., "What is an Artificial Neural Network?", http://www.emsl.pnl.gov/proj/neuron/neural/what.html.

[Kosko 1986] Kosko, B., " Fuzzy Cognitive Maps ", Int.J. Man-Machine Studies, Vol.24, 1986, pp.65-75.

[Kosko 1992] Kosko, B., "Neural Networks and Fuzzy Systems", Prentice Hall, 1992.

[Kosko 1997] Kosko, B., "Fuzzy Engineering", Prentice Hall, 1997.

[Leiner 2000] Leiner, B. M., et al, "A Brief History of the Internet", http://www.isoc.org/internet/history/brief.shtml, 2000.

[Mallot 1995] Mallot H. A., "Learning of cognitive maps from sequences of views" In: Proceedings, 3rd European Symposium on Artificial Neural Networks, Brussels, April 1995 (ESANN 95)

[Mohr 2003] Mohr, S., "The use and Interpretation of Fuzzy Cognitive Maps", Rensselaer Polytechnic Institute, June 2003.

[McNeill 1993] McNeill, D., "Fuzzy Logic", Simon & Shuster Inc, 1993.

[Navarre 2003] Navarre C., et al, "Are Automotive Suppliers Ready for e-Business? Some findings of an international survey", a CIRP, CERA and OSIP joint article, 2003.

[Nua 2002] "How many are online?", http://www.nua.ie/surveys/how_many_online/index.html.

[Ochoa 2003] Ochoa G., "Prey and Predator FCM", http://www.ochoadeaspuru.com, 2003.

[Petriu 1995] Petriu,E.M. and G. Eatherley, G., "Fuzzy Systems in Instrumentation: Fuzzy Control," In: Proceedings, IEEE Instrumentation and Measurement Technology Conference, pp.1-5, Waltham, MA, May 1995 (IMTC/95).

[Power 1997] Power, D. J., "What is DSS?", The On-Line Executive Journal for Data_Intensive Decision Support, Vol.1, No.3, October 21, 1997, http://dss.cba.uni.edu/papers/whatisadss.

[Sol 1985] H.G. Sol, C.A.Takkenberg and P.F. de Vries Robbé (editors), "Expert Systems and Artificial Intelligence in Decision Support Systems", Proceedings of the Second Mini Euroconference, Lunteren, The Netherlands, November 17-20, 1985.

[Vester] F. Vester, "The biocybernetic approach as a basis for planning our environment", Systems Practice, vol. 4, pp. 399-413.

[Vester 2001] F. Vester, "Simulating complex systems as sustainable organization by transparent sensitivity models", Lecture at Eurosim 2001 Congress, 21-29 June, Delft, 2001.

# Appendix A

ABC GROUP - 9 SEPT

- First I would like you present shortly ABC in terms of products.

- Firstly, ABC Group is a corporate head office located at 3 Newell Drive in Weston. It actually just moved here, about three week ago. It used to be the Head Office. The VIP Department is located here now. We are Canadian owned company and private. We have locations in Germany, Spain. We have a joint venture in Japan. Just European you want? We have four companies in the US. We have one in Brazil, one in Mexico.

- The companies are close to OEM staff, I guess.

- You mean Euro?

- Yes.

- The ones here, I guess we are close to Oshawa and that, but we do ship quite a bit of our stuff to the States with with ours are big they are big OEM. Actually, Chrysler, Honda, Ford, General Motors, all of the different divisions of General Motors, Freightliner, ICT, Johnson Control Receiving, Nissan, Packard, Cara Green, Johnson Control again, Mitsubishi, Subaru, Mac Truck, Exxon, Numi, I don't know if you know it is a joint venture between GM and Honda, PRW, Euro Technology, Volvo, Woodbridge and Mazda.

- OK. So you are Tier 1 and Tier 2?

- And Tier 3.

- Complex to understand.

- Yes it is.

- You are in the MIS department or IT Department?

- Yes.

- What are you responsible for?

- I am responsible for the day to day activities of the IT department and we also like (crash) connectivity with EM or any of the OEM.

- Can you talk about your ..quality.. regarding your consumers in terms of connectivity. What have you been doing?

- We connect electronically with all of our OEM. Right now we are direct with

Ford, although we are in the midst of going over to ANX with them. And General Motors in done Tier Van, EDS, which is their mandate. We have different ways of communicating with different OEMs which is wht they require.

- Have you got pure Internet connections?

- No. We are on an AM 400, yes. We do have Internet connections too. Like all of our GM is supply power and Ford is the Ford Security Network, and I believe Chrysler is, I am not sure of the name of it, but we're connected to them through the Internet as well as the AM-400 for EDI purposes.

- What kind of problems have you regarding the different expectations of your clients, is it... more complexity, or

- Yes it is. Chrysler is now mandating a system called POWER WARE of Covisint which we are getting involved in. We've actually got about four companies registered with it and we are in the midst of registering another five or six. But it is getting more complex which it seems to me that our quality engineering people spend a lot of time on the Internet now just to go in and do the things that OEM require.

- Do you think that Covisint is going to make it more easy for you?

- We don't know. We've had a presentation by them to show us what they are using and what Covisint is all about. But it is in its infancy. So we really don't know it yet. I don't think Covisint really knows either. They're getting their feet wet as well. But I mean this is the way it's got to be. You can't communicate the way you used to. It's got to be by electronic, because otherwise you would be on the phone all day.

- So you have been looking at Covisint functionalities, there are many of them in the...?

- Right now Covisint is, as I said it is in its infancy. Right now we are registering our companies with it for a Delfy division of GM. I guess they are not a division of GM anymore. Their mandate, Delfy's mandating it for purposes of - instead of using an Internet solution to go in and do our PRR and our quality stuff, they're actually, Delfy opts to use Covisint as their tool, and so we will be using that for Delfy to start with. There a number of quality parts in, let's see, at ..... there is an auction on Covisint, which one of our divisions is using, we don't use it obviously, but he is asking experts who participated in one of the auctions on it.

- Auction or reversed auction?

- Well I think it is bit of both. I haven't been involved in it myself. So I don't know a lot about it.

- Would it be possible to have the name of the person who was involved in this auction, do you know who?

- Yes.

- It would be very interesting to me to have perhaps his phone participation or something regarding specific issues.

- He is here?

- He has just been moved to a new location at ..... His fax number and his phone number will actually get him. Because he used to be here. They transferred him up there.

- OK, thank you. So you would say that the first application you're using within Covisint is related to auctions. That is the first thing you have been doing.

- Yes.

- What about the other applications you have been looking at? Are you intending to utilize them?

- Again, we will if we feel they're good obviously. But we don't know really what is on there a lot of it yet. And it is going to grow. It is in its infancy as I said repeatedly, but it will grow and they will add applications as they go too. So again we have to learn along with them.

- OK. Would you say that, let's say for example collaborated productsdesign, you got an application within Covisint package regarding ..DE.., would you say that you're going to go to Covisint or you are going to try and compare with other the software, what is going to be your policy?

- Right now most of our designs, we have a tad.. department of our own and we are actually hooked in to Ford and Chrysler in conjunction with them and a lot of design has been directly with them. So I am not sure how it will pan out with, there is a design option, I believe, on the Covisint, but I don't know if we will utilize it or not. It really isn't my department. It is the design department's.

- OK. What about the kind of pressure you have from Covisint or from the big three regarding connectivity and especially utilization of Covisint? Do they request you to use Covisint, or do they leave you completely free?

- No. In the case at Delfy, they've mandated it. Anyone who is dealing with Delfy must be ready to use Covisint. Now when it comes to Chrysler they're actually adopting an application, it is called power way, they are going into that with

forwardly and they are basically mandating that our company go on too. But our quality director is looking after that.

- OK. So that is the customer side of Covisint. What are you intending to do regarding your suppliers?

- Our suppliers! Well our suppliers right now we do EDI with our suppliers to software package on AS 400. So right at this moment we haven't really look into the supplier option of it.

- So you would say that at the very beginning you are going to deal with the customer relationship and that when this is established you are going to have a look at the supplier side,but not before, it is not a ...

- Not unless it is not really a necessity, because right now it is under control. We do do ..weekend ------- out to our suppliers.

- In the past have you been decreasing your supply base numbers to suppliers?

- Yes. Our purchasing department has, it is suppliers that are approved and if we need to buy something and it is not on the approved list, we need to give good reasons why we are going to use it basically the same as GM or Ford, whatever. Maybe were not as tight as they are but, you know.

- So it is going to be a shrewd consolidation with suppliers of all tiers...?

- I believe so. I believe that the way it is going. Because if you're going to tighten up your cost and everything, you have to cut down on the numbers.

- About connectivity, have you specific studies, financial studies for example regarding what connectivity or better connectivity could bring to your company.

- No. We now have a white Arian at work and his wife. When we decide to implement it, of course, we got quotes from different companies to implement it for us. Right now we are using a company called Economat, out of Montreal actually, and they weren't very happy with them.

- You're talking about consulting regarding the implementation of ..

- Yes.

- OK. So you are talking about investment costs.

- Did you try and assess the savings that you could have through better connectivity?

- No. We haven't done anything like that.

- Finally you say we have to go this way and we go. It is not based on financial survey, financial studies or whatever.

- No. I mean if GM says we have to communicate with them this way, we do it. I mean they're one of our biggest customer, so. We're customer driven here. But a lot of our product, most, 95% of our product is the plastic for the automotive. So any plastic on a car or truck, we make that. We don't make tires, but we do make gas tanks, any interior/ exterior plastic parts on a car, we pretty well make them. We have our own design department too. So that helps.

- Regarding your supply base, would you say that your suppliers are willing to get connected for strategic reason or are you pushing them to a better connectivity? Does it come from them or does it come from you?

- It depends on the supplier. We've had suppliers come to us and say, look we've got EDI capabilities, we would like to communicate with you. But in the majority of the cases we have gone to them and said look, we want to establish connectivity to ..trying means, rather than.... and some of them, quite a few of them are being cooperative and sure they run in to business where they need to do it anyway. Smaller ones are having a hard time with it. So we're looking at it through an Internet solution to give them an ability too.

- You wouldn't say that you are going to stop your relationship with this kind of company, you're going to help them go through this stage.

- Yes.

- OK. And through internet solutions that are less expensive than EDI?

- Yes. Everybody got the internet now.

- Are your proposing a software package or are you entering their companies to help them improve their processes or are you just requesting them to look at the poll?..

- The ones that have said no, we can't do EDI with them, what we've done is we're looking into getting an internet for them and when we get that in place, we will just go back and say look you can utilize this, you can send us our stuff in to that.

- Did you already do that?

- We have a couple of proposals on the table. Yes.

- How did they react?

- As far as I know right now, they are reacting fairly well. Like a lot of them are small companies and they don't have EDI capabilities, but they do have internet. So for them to send us an ..ASN..

- They need to invest in to new hardware or

- Well it depends on what equipment they've got in their house, if they..

- Not big equipment, anyway.

- No.

- What else major issues they are going through regarding the integration of the internet, because it is a question of not only hardware, software, it is a question of organizing processes, organizing the administrative services, training people and so and so. What would you say regarding these issues?

- The internet, I would say that it is so well publicized that everybody is on it right from the time they get up in the morning, but that's not the only thing I am finding might be a bit of an issue, a security issue with the internet. Some companies don't really want to put classified or you know critical information about their company on to the internet.

- And there is issues, I guess, regarding design or product development?

- Yes.

- What is going to be the solution regarding ...future deals....

- What will be the solution? I think you know, probably having a private. But right now we are hooked directly into Ford, so we don't have to worry about people coming in and having our information.

- You are talking about your relationship with Ford?

- No, I am talking about .... and security
-
- Yes, but your suppliers, they're small companies. I met with a company and she told me well about collaborated design, we won't go through the internet because of confidentiality issues and so on. So have you got solutions regarding

- No. Not as yet.

- Would you say it is something that is going to swallow-up better connectivity into that of collaborated product design?

- I think there will be an issue there and I think they're going to have to resolve something.
-
- You mean they, you mean Covisint or
- Well I think Covisint will actually eliminate a problem with security because they are highly secure, you know, but I think in general the internet is going to grow and grow and I think like with the ANX they have the issue of security, and I think they have eliminated them to a degree as they can. I think they are long term. There will be a resolution on it I believe.
- So you would say that if Covisint provides the supply chain with secure solutions, it is going to be through Covisint that collaborated design is going to take place?
- Yes. That is possible. Or any other secure, like ANX. That will be utilized too.
- ANX is,
- Automotive Network Exchange.
- Yes. All the big three are involved in ANX?
- Yes, yes.
- So how do you see ANX and Covisint's respective roles.
- I am not sure, because it is the way from EDI, they are basically different structures, but ANX is a lot of EDI to start with but they are going to branch out too. So they could be competitors, they're alike.
- And so ---------- that you
- No yet. Not yet. It may in the long run, but right now, like I said we've just got involved in Covisint and we are, actually, we're testing with them, probably next week. Ford is mandating that we use ANX, so.
-
- What do you think about this policy of being part of Covisant, and pushing companies to work with ANX?
- Well you know, it was always a big thing that the automotive companies always said, well we're going to merge and we are all going to be the same. But they will never be the same. Ford have their solution is better. We just take it as we can.
- So basically, what you are trying to do is to give your customers what they are expecting and if they say you are going to work with ANX, you work with ANX.

If they say you have to work with Covisint, you work with Covisint. It must require a lot of flexibility from DMI department as to flexibiliy.

- Well Covisint is handled basically through the internet, so as long as you have access to the internet, fine. Now as they grow it could be an issue. ...applications going there so you always have access to the internet. But you know, it could be an issue, security whatever. But right now it is not an issue, not by me. Maybe by our Design Department, I don't know. But I don't get involved in the design

- So you don't know what is happening in the Engineering Department. Do you know what the procurement or Department's position are regarding these issues. What do they think about it.?

- I haven't had a chance to talk to the purchasing manager, so I really can't comment on that.

- Well I think I've got all the information I was expecting regarding this side. Perhaps what I would like, if it is possible, to have a short form conversation with someone at the purchasing department and collaborated design or engineering. Could you give me one or two names of people I could go to.

- OK. This is for the auction. This number is the right one. Yes. And for purchasing there is Michael Quail, purchasing manager. ..... ..... .....

- Some of them are not located here.

- No, they are all located at ..... actually 2 New York Road ? is the address, outside of Toronto now. He is the Director of Engineering. They are all located up at that location.

OK. Thanks. – Well

ABC GROUP - 9 SEPT **[Edited version]**

- First I would like you present shortly ABC in terms of products.

- Firstly, ABC Group is a corporate head office located at 3 Newell Drive in Weston. It actually just moved here, about three week ago. It used to be the Head Office. The VIP Department is located here now. We are Canadian owned company and private. We have locations in Germany, Spain. We have a joint venture in Japan. Just European you want? We have four companies in the US. We have one in Brazil, one in Mexico.

- The companies are close to OEM staff, I guess.

- You mean Euro?

- Yes.

- The ones here, I guess we are close to Oshawa and that, but we do ship quite a bit of our stuff to the States with with ours are big they are big OEM. Actually, Chrysler, Honda, Ford, General Motors, all of the different divisions of General Motors, Freightliner, ICT, Johnson Control Receiving, Nissan, Packard, Cara Green, Johnson Control again, Mitsubishi, Subaru, Mac Truck, Exxon, Numi, I don't know if you know it is a joint venture between GM and Honda, PRW, Euro Technology, Volvo, Woodbridge and Mazda.

- OK. So you are Tier 1 and Tier 2?

- And Tier 3.

- Complex to understand.

- Yes it is.

- You are in the MIS department or IT Department?

- Yes.

- What are you responsible for?

- I am responsible for the day to day activities of the IT department and we also like (crash) connectivity with EM or any of the OEM.

- Can you talk about your ..quality.. [redacted]. What have you been doing?

- [redacted]. Right now [redacted], although we are in the midst of going over to ANX with them. And General Motors in done Tier Van, EDS, which is their mandate. [redacted].

---

**The first highlighted terms give us an idea of the type of connectivity ABC has with it's customers. It does not share a standardized connectivity tool with all OEMS.**

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- Have you got pure Internet connections?

- No. We are on an AM 400, yes. We do have Internet connections too. Like all of our GM is supply power and Ford is the Ford Security Network, and I believe Chrysler is, I am not sure of the name of it, but we're connected to them through the Internet as well as the AM-400 for EDI purposes.

- What kind of problems have you regarding the different expectations of your clients, is it... more complexity, or

- Yes it is. [redacted]. We've actually got about four companies registered with it and we are in the midst of registering another five or six. But it is getting more complex which it seems to me that our quality engineering people spend a lot of time on the Internet now just to go in and do the things that OEM require.

- [redacted]?

- [redacted]. We've had a presentation by them to show us what they are using and what Covisint is all about. But [redacted]. So we really don't know it yet. [redacted]. But I mean this is the way it's got to be. [redacted].

- So you have been looking at Covisint functionalities, there are many of them in the...?
[redacted]Right now Covisint is, as I said it is in its infancy. Right now we are registering our companies with it for a Delfy division of GM. I guess they are not a division of GM anymore. Their mandate, Delfy's mandating it for purposes of - instead of using an Internet solution to go in and do our PRR and our quality stuff, they're actually, Delfy opts to use Covisint as their tool, and so we will be using that for Delfy to start with. There a number of quality parts in, let's see, at ..... [redacted].

- [redacted]?

- [redacted]

- Would it be possible to have the name of the person who was involved in this auction, do you know who?

- Yes.

- It would be very interesting to me to have perhaps his phone participation or something regarding specific issues.

- He is here?

- He has just been moved to a new location at ..... His fax number and his phone number will actually get him. Because he used to be here. They transferred him up there.

- OK, thank you. [redacted]

- [redacted]

- What about the other applications you have been looking at? Are you intending to utilize them?

- Again, we will if we feel they're good obviously. [redacted]

---

This second set of highlights introduces COVISINT and it's capabilities as an auction and reverse auction connectivity tool. We see that ABC shows some interest in this tool, but is still unsure of it's capabilities since it is at it's infancy stages of development. *** This means that reverse auctions will be active in the ABC FCM with a doted arrow since it shows interest in this e-business tool. However the person being interviewed is not the one in charge of reverse auctions for ABC so we cannot establish a causality relationship using reverse auctions unless we extrapolate our own general conclusions based on solid facts. The doted arrow that is seen going from the reverse auctions node to the price node in Figure 4.1 is therefore portrayed in **red** rather then in green because of the general knowledge we have acquired through automotive experts, such as professor Navarre, and facts found in the 17 interviews. The negative correlation existing between the reverse auction node and the price node is based on the fact that OEMs use this connectivity tool to minimize costs, which from a supplier's point of view means lowering their prices. Consequently if reverse auctions increase the supplier's prices decrease.

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# Appendix B

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       0 0 -1 0 0 0 0 0 0 0 0 0 0 0 0;
       0 0 0 0 0 0 1 1 1 0 1 1 0 0;
       1 0 1 0 0 0 0 0 0 0 0 0 0 0 0;
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      1 0 0 0 1 -1 0 0 0 0 0 0 0 0 ;
      -1 0 0 0 0 0 1 0 0 0 0 0 0 0 ;
      0 0 0 0 1 0 0 0 0 1 0 0 0 0 ;
      -1 0 0 0 0 0 0 0 0 0 0 0 0 0 ;
      1 0 1 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 -1 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 1 1 1 0 1 0 1 0 ;
      1 0 1 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 0 0 0 1 0 0 0 0 ;
      0 0 0 0 0 0 0 0 0 0 0 0 0 0];

A14= [0 1 0 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 ;
      0 -1 0 0 0 0 0 0 0 0 0 0 0 0 ;
      1 0 0 0 1 -1 0 0 0 -1 0 0 0 0 ;
      -1 0 0 0 0 0 1 0 0 0 0 0 0 0 ;
      0 0 0 0 1 0 0 0 0 1 0 1 0 0 ;
      -1 0 0 0 0 0 0 0 0 0 0 0 0 0 ;
      1 0 1 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 -1 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 1 1 1 0 1 1 0 0 ;
      1 0 1 0 0 0 0 0 0 0 0 0 0 0 ;
      -1 0 -1 0 0 0 0 0 1 1 0 0 0 0 ;
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 0 0 0 0 0 0 0 0];

A15 = [0 1 0 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 ;
      0 -1 0 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 ;
      -1 0 0 0 0 0 1 0 0 0 0 0 0 0 ;
      0 0 0 0 1 0 0 0 0 1 0 0 0 0 ;
      -1 0 0 0 0 0 0 0 0 0 0 0 0 0 ;
      1 0 1 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 -1 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 1 1 1 0 1 0 0 0 ;
      1 0 1 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 ;
      0 0 0 0 0 0 0 0 0 0 0 0 0 0 ;
      -1 0 1 0 0 0 0 0 0 0 0 0 0 0];
```

```
A16= [0 1 0 0 0 0 0 0 0 0 0 0 0 0;
   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0;
   0 -1 0 0 0 0 0 0 0 0 0 0 0 0 0;
   1 0 0 0 1 -1 0 0 0 1 0 0 0 0;
   -1 0 0 0 0 0 1 0 0 0 0 0 0 0;
   0 0 0 0 1 0 0 0 0 1 0 1 0 0;
   -1 0 0 0 0 0 0 0 0 0 0 0 0 0;
   1 0 1 0 0 0 0 0 0 0 0 0 0 0;
   0 0 -1 0 0 0 0 0 0 0 0 0 0 0;
   0 0 0 0 0 0 1 1 1 0 1 1 0 0;
   1 0 1 0 0 0 0 0 0 0 0 0 0 0;
   -1 0 -1 0 0 0 0 0 0 0 0 0 0 0;
   0 0 0 0 0 0 0 0 0 0 0 0 0 0;
   -1 0 1 0 0 0 0 0 0 0 0 0 0 0];

A17 = [0 1 0 0 0 0 0 0 0 0 0 0 0 0;
   0 0 0 0 0 0 0 0 0 0 0 0 0 0;
   0 -1 0 0 0 0 0 0 0 0 0 0 0 0;
   1 0 0 0 1 -1 0 0 0 1 0 0 0 0;
   -1 0 0 0 0 0 1 0 0 0 0 0 0 0;
   0 0 0 0 1 0 0 0 0 1 0 1 0 0;
   -1 0 0 0 0 0 0 0 0 0 0 0 0 0;
   1 0 1 0 0 0 0 0 0 0 0 0 0 0;
   0 0 -1 0 0 0 0 0 0 0 0 0 0 0;
   0 0 0 0 0 0 1 1 1 0 1 1 0 0;
   1 0 1 0 0 0 0 0 0 0 0 0 0 0;
   -1 0 -1 0 0 0 0 0 1 1 0 0 0 0;
   0 0 0 0 0 0 0 0 0 0 0 0 0 0;
   0 0 0 0 0 0 0 0 0 0 0 0 0 0];


S=A1+A2+A3+A4+A5+A6+A7+A8+A9+A10+A11+A12+A13+A14+A15+A16+A17;
A=S;
for i=1:14;
   for j=1:14;
      if A(i,j)>0.5;
         A(i,j)=1;
      elseif A(i,j)<-0.5;
         A(i,j)=-1;
      end;
   end;
end;
fprintf(1,'\nThe compound matrix A=\n\n')
disp(num2str(A))
```

```
fprintf(1,'\n')

%'Case [...0 0 1]'
C1=[0 0 0 0 0 0 0 0 0 0 0 0 0 0 1];
fprintf(1,'The results for Case     C1=[0 0 0 0 0 0 0 0 0 0 0 0 0 0 1] are:\n')
iteration(C1,A)

%'Case [...0 1 0]'
C1=[0 0 0 0 0 0 0 0 0 0 0 0 0 1 0];
fprintf(1,'The results for Case     C1=[0 0 0 0 0 0 0 0 0 0 0 0 0 1 0] are:\n')
iteration(C1,A)

%'Case [...0 1 1]'
C1=[0 0 0 0 0 0 0 0 0 0 0 0 0 1 1];
fprintf(1,'The results for Case     C1=[0 0 0 0 0 0 0 0 0 0 0 0 0 1 1] are:\n')
iteration(C1,A)

%'Case [...1 0 0]'
C1=[0 0 0 0 0 0 0 0 0 0 0 0 1 0 0];
fprintf(1,'The results for Case     C1=[0 0 0 0 0 0 0 0 0 0 0 0 1 0 0] are:\n')
iteration(C1,A)

%'Case [...1 0 1]'
C1=[0 0 0 0 0 0 0 0 0 0 0 0 1 0 1];
fprintf(1,'The results for Case     C1=[0 0 0 0 0 0 0 0 0 0 0 0 1 0 1] are:\n')
iteration(C1,A)

%'Case [...1 1 0]'
C1=[0 0 0 0 0 0 0 0 0 0 0 0 1 1 0];
fprintf(1,'The results for Case     C1=[0 0 0 0 0 0 0 0 0 0 0 0 1 1 0] are:\n')
iteration(C1,A)

%'Case [...1 1 1]'
C1=[0 0 0 0 0 0 0 0 0 0 0 0 1 1 1];
fprintf(1,'The results for Case     C1=[0 0 0 0 0 0 0 0 0 0 0 0 1 1 1] are:\n')
iteration(C1,A)
```

```
function iteration(C,A)
R(:,:,1) = C;
for n=1:10
   R(:,:,n+1)=R(:,:,n)*A(:,:);
   fprintf(1,'Matrix multipl. result   C%g=',n+1)
   fprintf(1, mat2str(R(:,:,n+1)))
   fprintf(1, '\n')
   if R(1,12,n)==1
      R(1,12,n+1)=1;
   end
   if R(1,13,n)==1
      R(1,13,n+1)=1;
   end
   if R(1,14,n)==1
      R(1,14,n+1)=1;
   end
   for j=1:14
      if R(1,j,n+1)>0.5
         R(1,j,n+1)=1;
      else
         R(1,j,n+1)=0;
      end
   end
   for x = 1:n
      if R(:,:,n+1) == R(:,:,x)
         fprintf(1,'Normalized vector       C%g=',n+1)
         fprintf(1, mat2str(R(:,:,n+1)))
         fprintf(' *STOP*\n')
         fprintf(1,'Normalized vector       C%g=',x)
         fprintf(1, mat2str(R(:,:,x)))
         fprintf(' Previous Identic State\n\n')
         return
      end
   end
   fprintf(1,'Normalized vector       C%g=',n+1)
   fprintf(1, mat2str(R(:,:,n+1)))
   fprintf(1, '\n')
end
```

Fuzzy Cognitive Map Results

>> FuzzyCognMap

The compound matrix A=

```
 0  1  0  0  0  0  0  0  0  0  0  0  0  0
 0  0  0  0  0  0  0  0  0  0  0  0  0  0
 0 -1  0  0  0  0  0  0  0  0  0  0  0  0
 1  0  0  0  1 -1  0  0  0  1  0  1  0  0
-1  0  0  0  0  0  1  0  0  0  0  1  0  0
 0  0  0  0  1  0  0  0  0  1  0  1  0  0
-1  0  0  0  0  0  0  0  0  0  0  0  0  0
 1  0  1  0  0  0  0  0  0  0  0  0  0  0
 0  0 -1  0  0  0  0  0  0  0  0  0  0  0
 0  0  0  0  0  0  1  1  1  0  1  1  1  0
 1  0  1  0  0  0  0  0  0  0  0  0  0  0
-1  0 -1  0  0  0  0  0  1  1  0  0  0  0
 0  0  0  0  0  0  0  0  0  1  0  0  0  0
-1  0  1  0  0  0  0  0  0  0  0  0  0  0
```

The results for Case C1=[0 0 0 0 0 0 0 0 0 0 0 0 0 0 1] are:
Matrix multipl. result C2=[-1 0 1 0 0 0 0 0 0 0 0 0 0 0 0]
Normalized vector C2=[0 0 1 0 0 0 0 0 0 0 0 0 0 0 1]
Matrix multipl. result C3=[-1 -1 1 0 0 0 0 0 0 0 0 0 0 0 0]
Normalized vector C3=[**0 0 1 0 0 0 0 0 0 0 0 0 0 0 1**] *STOP*
Normalized vector C2=[0 0 1 0 0 0 0 0 0 0 0 0 0 0 1] Previous Identic State

The results for Case C1=[0 0 0 0 0 0 0 0 0 0 0 0 0 1 0] are:
Matrix multipl. result C2=[0 0 0 0 0 0 0 0 0 0 1 0 0 0 0]
Normalized vector C2=[0 0 0 0 0 0 0 0 0 0 1 0 0 1 0]
Matrix multipl. result C3=[0 0 0 0 0 0 1 1 1 1 1 1 1 1 0]
Normalized vector C3=[0 0 0 0 0 0 1 1 1 1 1 1 1 1 0]
Matrix multipl. result C4=[0 0 0 0 0 0 1 1 2 2 1 1 1 0]
Normalized vector C4=[**0 0 0 0 0 0 1 1 1 1 1 1 1 0**] *STOP*
Normalized vector C3=[0 0 0 0 0 0 1 1 1 1 1 1 1 0] Previous Identic State

The results for Case C1=[0 0 0 0 0 0 0 0 0 0 0 0 1 1] are:
Matrix multipl. result C2=[-1 0 1 0 0 0 0 0 0 1 0 0 0 0]
Normalized vector C2=[0 0 1 0 0 0 0 0 0 1 0 0 1 1]
Matrix multipl. result C3=[-1 -1 1 0 0 0 1 1 1 1 1 1 1 0]
Normalized vector C3=[0 0 1 0 0 0 1 1 1 1 1 1 1 1]
Matrix multipl. result C4=[-1 -1 1 0 0 0 1 1 2 2 1 1 1 0]
Normalized vector C4=[**0 0 1 0 0 0 1 1 1 1 1 1 1 1**] *STOP*
Normalized vector C3=[0 0 1 0 0 0 1 1 1 1 1 1 1 1] Previous Identic State

The results for Case C1=[0 0 0 0 0 0 0 0 0 0 0 1 0 0] are:
Matrix multipl. result C2=[-1 0 -1 0 0 0 0 0 1 1 0 0 0 0]
Normalized vector C2=[0 0 0 0 0 0 0 0 1 1 0 1 0 0]
Matrix multipl. result C3=[-1 0 -2 0 0 0 1 1 2 1 1 1 1 0]
Normalized vector C3=[0 0 0 0 0 0 1 1 1 1 1 1 1 0]
Matrix multipl. result C4=[0 0 0 0 0 0 1 1 2 2 1 1 1 0]
Normalized vector C4=[**0 0 0 0 0 0 1 1 1 1 1 1 1 0**] *STOP*
Normalized vector C3=[0 0 0 0 0 0 1 1 1 1 1 1 1 0] Previous Identic State

The results for Case C1=[0 0 0 0 0 0 0 0 0 0 0 1 0 1] are:
Matrix multipl. result C2=[-2 0 0 0 0 0 0 0 1 1 0 0 0 0]
Normalized vector C2=[0 0 0 0 0 0 0 0 1 1 0 1 0 1]
Matrix multipl. result C3=[-2 0 -1 0 0 0 1 1 2 1 1 1 1 0]
Normalized vector C3=[0 0 0 0 0 0 1 1 1 1 1 1 1 1]
Matrix multipl. result C4=[-1 0 1 0 0 0 1 1 2 2 1 1 1 0]
Normalized vector C4=[0 0 1 0 0 0 1 1 1 1 1 1 1 1]
Matrix multipl. result C5=[-1 -1 1 0 0 0 1 1 2 2 1 1 1 0]
Normalized vector C5=[**0 0 1 0 0 0 1 1 1 1 1 1 1 1**] *STOP*
Normalized vector C4=[0 0 1 0 0 0 1 1 1 1 1 1 1 1] Previous Identic State

The results for Case C1=[0 0 0 0 0 0 0 0 0 0 0 1 1 0] are:
Matrix multipl. result C2=[-1 0 -1 0 0 0 0 0 1 2 0 0 0 0]
Normalized vector C2=[0 0 0 0 0 0 0 0 1 1 0 1 1 0]
Matrix multipl. result C3=[-1 0 -2 0 0 0 1 1 2 2 1 1 1 0]
Normalized vector C3=[0 0 0 0 0 0 1 1 1 1 1 1 1 0]
Matrix multipl. result C4=[0 0 0 0 0 0 1 1 2 2 1 1 1 0]
Normalized vector C4=[**0 0 0 0 0 0 1 1 1 1 1 1 1 0**] *STOP*
Normalized vector C3=[0 0 0 0 0 0 1 1 1 1 1 1 1 0] Previous Identic State

The results for Case C1=[0 0 0 0 0 0 0 0 0 0 0 1 1 1] are:
Matrix multipl. result C2=[-2 0 0 0 0 0 0 0 1 2 0 0 0 0]
Normalized vector C2=[0 0 0 0 0 0 0 0 1 1 0 1 1 1]
Matrix multipl. result C3=[-2 0 -1 0 0 0 1 1 2 2 1 1 1 0]
Normalized vector C3=[0 0 0 0 0 0 1 1 1 1 1 1 1 1]
Matrix multipl. result C4=[-1 0 1 0 0 0 1 1 2 2 1 1 1 0]
Normalized vector C4=[0 0 1 0 0 0 1 1 1 1 1 1 1 1]
Matrix multipl. result C5=[-1 -1 1 0 0 0 1 1 2 2 1 1 1 0]
Normalized vector C5=[**0 0 1 0 0 0 1 1 1 1 1 1 1 1**] *STOP*
Normalized vector C4=[0 0 1 0 0 0 1 1 1 1 1 1 1 1] Previous Identic State

>>