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STRATEGIC RESPONSES TO DEFENCE SECTOR RESTRUCTURING

by

Jason Weatherbie, B. Comm. (Honours)
Post Graduate Diploma (Marketing/R&D Management)

A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfillment of
the requirements for the degree of

Master of Management Studies

School of Business
Carleton University
Ottawa, Ontario

January, 1999
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acceptance of the thesis

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A handwritten signature in cursive script, appearing to read 'Kumar', written over a horizontal line.

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ABSTRACT

The defence market has been facing dramatic cutbacks since the end of the Cold War. In response, there has been an industry-wide restructuring taking place. Defence sector restructuring is a major undertaking involving hundreds of Canadian firms. Due to the fact that there had been little previous research into this area, this study attempts to provide some recommendations regarding successful strategies for such defence firms. Investigated in this study are the correlations between the particular attributes of defence firms and the strategies they elect to pursue.

The study reports on the findings obtained through a country-wide mail/fax survey of 80 Canadian defence firms. The data was analyzed using logistic regressions and a seemingly unrelated regression (SUR) analysis. Conclusions have been drawn in an effort to provide some direction for managers of defence companies faced with these cutbacks. The study reveals that the majority (75%) of defence companies are pursuing diversification to some degree. Diversification has been identified as the most successful strategy whereas Downsizing is the least successful. Company size and age, as well as the companies defence dependency and restructuring experience are significantly correlated with the selection of a strategic response.

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1. INTRODUCTION

At the height of the Cold War, billions of dollars were spent by North American governments for the research and development of a wide range of advanced weapons systems (Brandt, 1994). With the end of the Cold War came a corresponding reduction in the budget allocated to the Defence sector. Consequently, there is currently a period of dramatic change within the industry as companies scramble to cope with the reduced demand for their products and services.

Presently, there are a number of possible strategies available to firms in order to deal with these cutbacks. However, not every strategy is optimal or even appropriate for each individual defence firm. Many individual factors must be considered before pursuing any of the various strategies. Therefore, a company must evaluate each of these factors, with respect to their operations, before deciding on a course of action.

The objective of this study was to identify the factors influencing a company's strategic response to changes in the defence market and then arrive at certain conclusions regarding the optimal strategy for a defence firm given their individual company attributes. Identifying these correlations has provided other defence firms with useful information and some direction when planning their restructuring strategy(s).

2. LITERATURE REVIEW

In previous periods of reduced defence spending, defence firms have typically been shrinking and waiting for better times (Aeroe, 1993). However, unlike past cutbacks in defence spending, this one appears to be long-term with no dramatic increase in spending within the foreseeable future (see Figure 1). Five years ago, Canada's Department of National Defence spent \$12 billion a year, but that level has been declining ever since and in 1998-99, only \$9.3 billion is to be spent. In the United States, the national defence budget sits at approximately \$230 billion, 30 percent less than five years ago. (Ray, 1998) With the reduction in the demand for defence products and services, the prime contractors and, more significantly, the sub-contractors have had to develop business strategies to survive the restructuring in the defence industry.

The literature review is divided into three principal sections. The first section outlines the differences between prime versus sub-contractors and how they are affected by the cutbacks. The second section covers the various restructuring strategies which are typically undertaken by the defence firms. The final section deals with the different factors which may influence a company when deciding upon a particular strategy(s).

2.1 Prime Versus Sub-Contractors

The military industrial complex is dominated by relatively few large firms, which are known as the prime contractors. These prime contractors ('primes') are very large companies employing tens of thousands of workers and with annual net sales of several billion dollars (Aeroe, 1993). Although the 'primes' are heavily defence-dependent companies, no 'primes' are devoted exclusively to defence production

(Aeroe, 1993). Roughly half of the contracts (in dollar terms) the 'primes' receive is subcontracted to other firms. This amount is split approximately 50:50 between other 'primes' and smaller firms.

Figure 1 Boom and Bust in Defence Spending

Boom and Bust in Defense Spending

Defence spending since World War II has grown at a baseline average rate of 0.7% per year. The annual DOD budget has grown faster and slower than this rate, peaking in real terms above the long term average in 1984. The cyclical nature of growth predicts a major downturn for the early 1990's, bottoming out in the late 1990's at \$213 billion, an \$80 billion drop from the present level.

(Lundquist, 1992)

This reflects not only the important role which the prime contractors play as subcontractors to each other but also the substantial involvement of small and medium-sized firms in defence production (Aeroe, 1993). Since the start of the post-Cold War reductions, the sales of most defence-oriented companies have declined, many firms have failed, and millions of defence industry workers have lost their jobs. This study will be investigating the effects of the reduction in defence spending at an organizational level and, therefore, not in terms of individual workers.

The degree to which these defence cutbacks are affecting the various contractors is dependent on which area of the defence industry the particular firm conducts its business. Among the prime contractors, those in aerospace and hardware (i.e. tanks) are the most seriously hit by budget reductions (Aeroe, 1993; Perry, 1993). Procurement of these products has greatly diminished since the end of the Cold War. Those 'primes' in electronics and communications, however, have not faced as many cutbacks as defence companies in other sectors (see Table 1). They also benefit from having many civil applications for their products (Aeroe, 1993; Curran, 1992; The Economist, 1992).

Table 1 Sizing Up the Coming Shakeout

	Decrease in contract obligations, 1985-1990	Decrease in prime contracts awarded, 1985-1990
Aircraft Industry	52	17
Communications Equipment	33	16
Electronic Components	40	16
Guided Missiles	35	35
Tanks	56	37

The number of DOD contracts awarded is down, but not nearly as much as overall defence spending. That means overcapacity and probably reduced subcontracting, neither of which is good for the defence electronics supplier base. "One thing is clear," says Defence Budget Project analyst Conrad Schmidt, "Someone other than the primes have been absorbing the blow."

Source: Defence Budget Project

(Burrows, 1992)

Subcontractors who are specialized with niche products applicable to both civil and defence markets are also less vulnerable to the cutbacks. However, as defence production is extensively based on subcontractors, the reduction of major defence

programs has knock-off effects which ultimately spread to increasing numbers of subcontractors (Aeroe, 1993). For an example of the fall-out effects from the cutbacks on the various contractors and suppliers please see Appendix 1.

2.2 Strategies

Presently, there are a number of possible strategies which defence companies can pursue in order to cope with the reduction in defence spending. Most companies will, in fact, pursue more than one of these strategies concurrently. However, not every strategy is optimal or even appropriate for each individual defence firm. A firm survives by expanding and contracting, by investing and divesting, and by acquiring and abandoning. These are the actions of a healthy and responsive company and not a sick and declining one (Kalra & Deibler, 1992). The appropriate strategy(s), however, is dependent on the particular company in question. These strategies include; Downsizing, Consolidation, and Diversification.

2.2.1 Downsizing

Downsizing is the act of reducing the size of the company through divestments, plant closures, and/or layoffs. Although downsizing is a popular strategy and many companies have done so effectively during these times of tight spending, there are many who criticize this approach. It is argued that more often than not, one round of downsizing merely leads to another. Gary Hamel, an expert on competitiveness who teaches at the London Business School, states that "this continuous downsizing - it's corporate anorexia. You can get thin, but it's no way to get healthy" (Henkoff, 1994). However, it is agreed even by its opponents that downsizing can be done effectively

without layoffs through careful restructuring using sell-offs¹, spin-offs², and redeployment of the workers of closed plants. Proponents of downsizing have many compelling arguments in favor of downsizing. Many argue that the old survival strategies of commercialization, diversification, and globalization hold little promise for many of today's defence firms (Lundquist, 1992).

The obvious conclusion for many of these companies is to make cuts that outpace declining revenues. However, they must do so intelligently with a clear plan of attack. This means finally owning up to massive overcapacity, overstaffing, and inefficiency, and then taking steps to eliminate these detrimental aspects of the business. Through downsizing, the goal is to structure the company's core businesses to gain preeminence in their segments. The options are to strip down, shut down, sell, swap or spin off units of the company in order to salvage the profitable from the unprofitable. (Lundquist, 1992)

It has been argued that a substantial downsizing is the most sensible response to the greatly reduced market for military equipment being experienced by defence firms nowadays. The sooner the contractors reduce their excess capacity, the greater will be their ability to withstand the rigors of the new military marketplace (Weidenbaum, 1992).

¹ Sell-off: A sell-off is characterized by the divesting firm exchanging its operating assets for cash, other operating assets, or securities of the acquiring firm. (Kalra & Deibler, 1992)

² Spin-off: A spin-off results in the creation of a new entity through a reduction of assets for the divesting firm. (Kalra & Deibler, 1992)

Opponents of downsizing still stress; downsize if you must, but don't expect a payoff unless you do so with a well thought-out strategy that enables you to support your survivors and continue to invest in your core competencies (Henkoff, 1994). Many analysts conclude that both downsizing and restructuring are often unsuccessful in achieving the goals sought by organizations. (Leatt, Baker, Halverson, and Aird, 1997)

Although most companies tend to combine their downsizing activities with other strategies, General Dynamics (GD) is one of the few to stick to a purely downsizing strategy (Berss, 1989). GD, the second largest defence contractor in the U.S., provides strictly military products for the government. In response to the cutbacks, CEO William A. Anders announced a downsizing plan where they would not diversify but instead focus on their core competencies: space launch vehicles, tactical military aircraft, armored vehicles, and nuclear submarines. Anders stated that GD would remain in business only where it could be #1 or #2 in the market, and only if it could achieve 'critical mass' with production large enough to justify dedicated factories (Dial & Murphy, 1995; Perry, 1993). He also announced his intention to sell units outside these four core defence businesses. While a few contractors have divested unprofitable non-core businesses where they had little chance of building strategically competitive positions, only General Electric followed GD in exiting key segments of the defence industry. One study on prime contractor strategies shows that while most contractors adopted a combination of strategies, all adopted some form of downsizing or consolidation to reduce excess capacity (Dial & Murphy, 1995).

Loral, another premier defence contractor, has followed many strategies including growing international sales, exploring nonmilitary applications for its technology, and also downsizing. Loral has six core businesses and has cut their non-core businesses while acquiring other ones to bolster existing divisions. They have

also restructured by laying off workers, shutting plants and reallocating resources (Lundquist, 1992).

Rockwell, a prime contractor geared towards growth rather than downsizing, is following a strategy of balanced diversification. However, they have recently sold three businesses, eliminated several unprofitable product lines, and closed some plants while consolidating others (Lundquist, 1992).

Some companies, especially smaller sub-contractors, exit the defence industry completely in favor of commercial markets. Other companies, who are not so lucky and are unable to access commercial markets successfully, have been forced to close their businesses. This is the most extreme form of defence downsizing and is usually only a last resort. However, sometimes the best course of action for the shareholders is to liquidate the company.

Evidently many firms are downsizing to some extent. This strategy, therefore, must be considered when attempting to adjust to the harsh reality of a reduced defence budget.

2.2.2 Consolidation

Norman Augustine, the CEO at Martin-Marietta, feels that for most of the defence contractors the only viable option is that of consolidation. "This requires bringing together companies in a fashion which builds critical mass, reduces overhead through economies of scale, enables sharing of technology, and builds premier organizations which can compete effectively" (Miller, 1994). Consolidation is, therefore, another popular strategy being pursued by defence firms.

Building on the thoughts of Mr. Augustine, consolidation is defined as an intensification of focus on existing capabilities and markets by bringing together

companies in a fashion which builds critical mass, reduces overhead through economies of scale, enables sharing of technology, and builds premiere organizations which can compete effectively. To strengthen their position in the defence sector, several large defence companies have merged, while others have acquired certain defence divisions of competitors in order to bolster their core competencies. When firms can consolidate their assets and improve efficiency, there will be an improvement in performance (Anand and Singh, 1997).

Anders, the CEO of GD, was publicly urging the industry to both downsize and consolidate its businesses in order to 'rationalize excess capacity'. He argues that only the top one or two contractors in a particular segment could survive the coming shake-out in defence (Dial & Murphy, 1995).

The push to consolidate signals the desire of the surviving companies to remain solidly in the defence market place, where they enjoy near-monopolies owing to their understanding of both the business and the customer. Also, past failures in conversion have made many contractors skeptical of conversion schemes. Many will downsize, consolidate, or purchase other defence divisions and plan on staying largely defence contractors. (Brandt, 1994)

Consolidation can be accomplished through mergers, acquisitions, or strategic alliances and partnerships. Mergers and acquisitions have played a large role in many of the prime contractors' strategies. Five of the top defence contractors (GM Hughes, Grumman, Lockheed, Martin-Marietta, and McDonnell-Douglas) adopted GD's critical mass criteria and sought to achieve critical mass in production through acquisitions. (Dial & Murphy, 1995)

By merging, acquiring, and, in effect, consolidating businesses, these defence contractors have managed to lower their overhead costs and avoid duplication of research and development expenses (Lundquist, 1992). The industry trend towards consolidation to exploit economies of scale has continued with the giant mergers of Lockheed and Martin-Marietta as well as Northrop and Grumman.

Consolidation strategies of increased market share and economies of scale in an immense but declining industry requires an acquisitive firm to be large enough to finance a huge takeover bid. Since smaller defence firms do not have the necessary resources to be a suitor, if they want to combine with an industry giant, the merger must be sold on the basis of strategic fit. Smaller firms must persuade the larger companies that they have value-enhancing qualities to offer (Shanklin, 1995).

Another popular means of consolidation within the defence industry is the formation of strategic alliances. A strategic alliance offers many of the same benefits but is a more cautious approach than outright merger and acquisition. A strategic alliance can be defined as a collaborative agreement between two or more firms which contribute assets or resources to a common endeavor while maintaining their individuality and independence. (Dussauge & Garrette, 1993) When focusing on consolidation, the partners are usually rival firms and therefore does not include partnerships for the sake of diversification into commercial markets. Because they wish to maintain their own identity, many firms are turning to strategic alliances and partnerships to find new, more permanent ways to cut costs. By using alliances, firms can grow existing businesses and invent new ones to achieve sustainable competitive advantage (Bruce & Shermer, 1993). Harvey Wiseberg, a consultant with Advanced Technology Advisors, advises subcontractors with significant defence work that teaming up with a competitor may be the best route to survival (Mraz, 1993).

Essentially, the scope of an alliance covers at least one of three functions; R&D, Manufacturing, or Marketing. Alliances in the defence industry rarely focus on marketing as there is only one buyer, the government. However, defence firms which are now pursuing commercial markets are forming alliances for just this reason. This will be discussed further in the section on diversification.

One category of strategic alliances which appeals to many high-tech firms, like defence contractors, is licensing technology to companies with the expertise and the customer contacts to market it. This approach enables each participant to focus on what it does best (Shanklin, 1995).

There are many examples of alliances being established both here and abroad. The General Electric Co. of the U.K. entered into a broad alliance with Finmeccanica of Italy to cooperate on defence products and R&D in order to better position itself for the inevitable consolidation of the defence industry in Europe (Morrocco, 1997). In order to compete on a level playing field with the giant U.S. companies, further alliances are taking place such as between the Lagardere group and Thompson-Matra, two defence-electronics companies.

2.2.3 Diversification

Another popular yet highly risky strategy for defence firms is that of diversification. For this study diversification is defined as the reduction of a company's dependence on defence by acquisition or organic growth of non-defence operations (Smith & Smith, 1992). The outlook of some defence companies is that if they can diversify into other fields then they will be in a better position to offset losses experienced in the defence sector. Many defence firms find themselves in a position where they can no longer rely on defence contracts. The result is that they must either

greatly reduce their dependence on defence contracts through diversification or face the future with a shrinking business base and, therefore, possible extinction. (Minnich, 1993) However, it has been shown through many failed attempts that diversification is the riskiest corporate growth strategy of them all. Even so, for many companies the key to survival is diversification, spreading business between commercial and military customers so that it is not totally dependent on a continued level of defence spending (Mraz, 1993). It is a very common mistake to speak about conversion when in reality one is facing another form of diversification. Conversion, which will be discussed later, involves converting military products, processes, etc. into commercial applications where diversification is simply pursuing any other non-defence areas of business. Essentially, conversion is a subset, or one method, of diversification.

There has been much debate over the merits of diversification for defence firms. Unlike civilian companies there is much more to consider when a defence firm elects to enter a new market. The reasons for this will be discussed in a later section. There exists a wide variety of conflicting reports concerning the success of defence firms when diversifying into new fields. Much of the academic literature concerning diversification is extremely skeptical about this strategy. It has been stated that diversification is to be treated with caution (Campbell, 1992), that it has not lived up to expectations (Howe, 1986), that diversification had little positive impact on performance (Whittington, 1991), and that diversification is basically a negative strategy involving companies running away from fundamental problems (Kastens, 1973). When talking of defence firms converting into commercial market, Norman Augustine, the CEO of Martin-Marietta, stated his famous quote that "our industry's record at defence conversion is unblemished by success" (Dial & Murphy, 1995). Obviously this is an exaggeration, but does indicate how many feel that this strategy is not a very

successful one! One example (Shanklin, 1995) compares defence diversifiers to new companies or "startups". He states that 60% of startups do not last three years and a large defence contractor looking to branch out into radically new businesses has many of the same characteristics as these startups. Although diversification is often viewed as a panic measure which suffers from a lack of strategic planning (Bishop, 1995), there remain many advocates for this particular strategy. Obviously, since an increasing number of defence firms are turning to such measures, there must be some level of success. As mentioned earlier, there are those who feel that diversification is the only chance for survival of some firms. Others, such as Barbara Cooper the public information director for the Centre of Innovative Technology, feel that diversification is "good business whether you're a defence subcontractor or not" (Mraz, 1993). Many advocates of diversification find it interesting that while it is much easier for a financially healthy company to transform itself, defence companies seem to wait until they are in periods of great financial difficulty before seriously considering diversification (Minnich, 1993).

As with most strategies there will always be some discussion regarding the effectiveness of diversification. However, if this particular course of action is chosen, one point has been made repeatedly. Do not diversify into unrelated areas of business. The key to successful diversification is building on the core competence of business and that superior performance through diversification is primarily based on relatedness (Very, 1990).

Diversification can fall into basically two areas; unrelated, usually through acquisitions, and related, often through mergers, alliances, and/or conversion. New, unrelated areas of business are the most risky for defence firms as they are moving away from what they know best. Alternatively, related areas offer new markets while

maintaining some of the expertise the company has in the area. There exist many examples of failed diversification attempts into unrelated fields. Grumman Corp., for instance, erred spectacularly, and very publicly, in building municipal buses. Boeing Co. had no better success with trolley cars, McDonnell Douglas Corp. with computer services, Northrop Corp. with pollution controls, Martin Marietta Corp. with environmental services, and Rockwell International Corp. with digital watches (Miller, 1994).

Diversification is usually accomplished through mergers, acquisitions, alliances, and/or the conversion of military technology into commercial applications. Diversification via acquisitions or mergers with other firms is a strategy employed by most defence firms. Mergers and acquisitions are being used to gain a fairly rapid foothold into commercial markets. Acquisitions have been a key method for various midsize companies to diversify, and they will continue to play an important role. For certain contractors, such as Tracor, a defence electronics company, acquisitions are being used to accelerate growth and expand the company's portfolio of core businesses (Velocci Jr., 1996).

Many firms involve themselves in diversification via strategic alliances with other firms, both within the defence and commercial markets. Rockwell, for example, is "employing both acquisitions and strategic alliances to penetrate further into new civil fields, as well as to exploit synergies between these new areas and the expertise already possessed" (Aeroe, 1993). Many sub-contractors focus on a certain niche market, such as the production of high-tech components, called specialization, and then rely on strategic partnerships to complete the sale of the products through marketing, distribution etc.. The smaller subcontractors have no alternative but to enter into these alliances if they are to be successful in diversifying.

Another means by which defence firms are dealing with the cutbacks is conversion, a sub-category of diversification. As stated earlier, conversion and diversification are often confused with one another. While diversification is the act of reducing a firm's dependence on defence contracts by pursuing non-defence markets, conversion is one method for achieving this goal. Conversion can be broadly defined as a shift from military to civil production through the adaptation of the existing military technological, capital, and skills base - an 'organic' growth into new product areas and new markets (Harbor, 1990).

Another term often used in association with defence conversion is 'dual-use' technology. Dual-use technology can be defined as technology which has both military and commercial applications (Alic, Branscomb, Brooks, Carter & Epstein, 1992; Howe Jr. & Blanchard, 1992; Pipinich, 1993).

Both spin-on and spin-offs are aspects of dual-use technology. A spin-on uses existing non-defence, commercially viable technologies in defence systems (Brandt, 1994). As military production becomes a much smaller part of the high technology market, military requirements will increasingly come to rely upon the civil technology base (Walker and Willett, 1993). Internationally, the implication is that countries and firms which are the leaders in civil technology will ultimately gain competitive advantage in defence technology (Walker and Willett, 1993). This topic is, however, beyond the scope of this study. Spin-offs are those that use defence technology for non-defence, commercially viable products or processes (Brandt, 1994). When discussing the conversion of defence firms into related areas of non-defence markets, we are therefore dealing with the spin-off aspect of dual-use technology.

As with overall diversification, there are many opponents to conversion. Once again, the arguments stress the high failure rate and lack of knowledge when dealing

with commercial markets. There are, however, many more critics willing to accept the conversion of defence technology into commercial applications, a related area, rather than simply diversifying into completely new territories through acquisitions. The key to successful diversification is sticking with areas in which the company has some expertise. Conversion of a company's military technology does just that. Many firms have come to realize this the hard way. Lately, Grumman has not strayed from its areas of expertise. "We've learned from our past failures in diversification", remarked Harry Armen, director of research. "This time we're sticking with technologies that we know about" (Miller, 1994).

Michael Armstrong, CEO of GM Hughes Electronics, has stated that its main focus is to "leverage what we know how to do. Market history is littered with the remains of businesses that departed from what they were good at" (Miller, 1994).

The two main reasons conversion is more successful than simple diversification is that the firm already has the expertise in the area and since most of the technology is of a high-tech nature, other commercial firms find it difficult to match these products. Defence firms that turn out consumer goods which don't rely on their specialized knowledge, can easily be matched by other commercial manufacturers (Bloomberg News, 1996).

One giant obstacle for many of the defence firms interested in using a conversion approach is the fact that many defence products have no commercial applications. Those companies involved with strictly military products will have no success in the commercial markets. Conversion is not much of an option for firms such as General Dynamics (GD), where it would be difficult to find a market for civilian tanks or submarines. Many of these firms tend to be the largest defence suppliers and, therefore, will most likely remain strong defence companies. Business consultant

Anthony J. Marolda has stated that "you cannot be successful in commercializing defence technology if you don't have technology that can be used outside the defence arena" (Sandler, 1992).

Those companies in the electronics and communications fields will find conversion a much easier task than those in other areas of the defence industry. Given the booming electronics market, conversion will obviously be easier for electronics companies like Hughes than it is for tank manufacturers such as GD.

As R. Noel Longuemare, an executive at Westinghouse Electric Corporations Electronic Systems group, puts it, "we see a great opportunity to expand that business into non-DOD (Department of Defence) markets because almost everything we do in electronics-our main business-can have non-DOD uses" (Curran, 1992). There will also be great opportunities in satellite communications, an area in which defence companies have years of experience.

Although there are critics constantly pointing out the obstacles and high failure rates in conversion, there are many success stories. In pursuing programs which convert defence technology to civilian uses, Thomson-CSF, a large French electronics company, took their company's radar and display know-how and turned it into successful air traffic control systems. Another positive example is Hughes Aircraft who wanted to exploit civilian markets where they were at home with both the technology and distribution channels. Hughes has many successful civilian products already on the market. When they found markets which Hughes had proprietary technology, but little experience, they decided to combine strategies, using conversion as well as other ways of entering new markets, such as licensing and joint ventures (two types of alliances) as well as acquisitions. This was the case for their sound

retrieval system as Hughes licensed the technology rather than attempt to develop marketing and distribution channels of its own (Watson, 1992).

Sometimes defence companies are very lucky and can apply their defence technology directly to commercial opportunities. Such is the case with M/A-COM, a supplier of microwave components and connectors, who are fortunate enough to be able to sell many of their military microwave components directly into the commercial markets (Curran, 1992).

Ratheon, one of the largest U.S. defence contractors, also saw a need for a shift towards a healthier ratio of commercial to defence business. Consequently, they encouraged (dual-use) technologies that might be useful to both military and commercial customers and would utilize the company's engineering and manufacturing skills. Examples can be seen in civilian air traffic control (precision guidance systems) and in personal communications applications (handheld portable personal and mobile telecommunications) (Curran, 1992).

Irvine Sensors Corporation, a smaller defence firm, invented a highly compact packaging scheme for integrated circuits (IC) called 'cubing' which showed promise for the low-cost manufacturing of commercial products as well. Their strategy was to form strategic alliances with larger corporations, such as IBM Corp., in order to commercialize their technology (Watson, 1992).

Qualcomm Inc., a digital wireless communications company, was once strictly a defence company. Today, after commercializing their spread-spectrum techniques for the growing cellular telephone market, most of their revenue comes from non-defence companies (Watson, 1992).

GEC-Marconi, the electronics arm of General Electric Co., is finding applications for its expertise in aviation electronics in the civil aviation sector. However, they are

also adapting their expertise to civil systems that have no direct military equivalent. One example is the Marconi in-flight entertainment system (IFES) which provides a phone and an audio-video system at every seat (Riezenman, 1992).

Synetics Corp. originally a designer of navigation, guidance, and missile control systems for the Navy, has dramatically shrunk its dependence on defence through the commercialization of their technologies. Besides producing non-defence products, such as the decision support system for human and material resources for the Coast Guard, they have also spun off a new company called Internetix for commercial applications (Sandler, 1992).

A final example of the successful conversion of military technology can be found at Sonalysts, a military service provider. Their commercial products range from an electronic fish net which keep fish out of nuclear reactor cooling intakes to a broadcast-quality studio that produces state-of-the-art computer animation. Sonalysts, who specialize in developing anti-submarine warfare systems, have even contributed the sound effects for the movie "The Hunt For Red October" which won an Academy Award for its soundtrack (Sandler, 1992).

The fact that successful conversion of defence technology to commercial applications exists is clearly evident. However, it still remains extremely risky. Besides the usual risk associated with the introduction of a new product into the commercial market, defence firms have many more obstacles that must be overcome in order to be on a level playing field as civilian companies. As such, the process of converting swords into plowshares will not necessarily be easy or quick (Chan & Sommer, 1996).

Some argue that although conversion is a viable strategy, defence firms just cannot effectively do business in commercial markets. As Jon Butler, president of Quarterdeck Investment Partners, put it, "I recommend converting (defence)

technology, but you can't convert the people. It's a different mind-set. Defence and Commercial people think differently. It's better to put the technology into a separate company" (Scott, 1995).

The fact that commercial and military markets are so completely different is a major stumbling block associated with diversifying to any degree into commercial work. (Quigley, 1991; Clark Jr., 1994) "Over the decades, the unique missions of the cold war shaped an entire segment of the American economy. Between defence firms and their civilian counterparts there grew a wall of separation more durable than another product of the cold war, the Berlin Wall" (Markusen & Yudken, 1992).

The differences between the two markets are very apparent as Michael Beltramo, a management consultant, points out. "Firms heavily involved in defence work face very poor prospects because it's such a totally different environment. Instead of one customer you have a lot of customers; instead of high regulation, you have relatively limited regulation; and time to market is much shorter as well. The differences in doing business in commercial and defence marketplaces are so profound that if you aren't already doing commercial work, it's pretty much hopeless" (Mraz, 1993).

Many executives feel that this is the most unlikely survival path of all. Jack Modzelewski, VP of aerospace and defence for Paine Webber, noted that "a book about successful diversification in the defence industry would be the shortest book ever written" (Burrows, 1992). Unless many factors are considered and dealt with properly, it would seem that attempts to shift into civilian products "will generally be unsuccessful because of mismatches between defence and non-defence experience, skills and technology, but primarily because of the defence oriented company culture and management style which militate against civilian success" (Alexander, 1990).

Essentially, defence contractors produce small numbers of very complex, high-value weapons systems or subsystems, while meeting stringent technical and performance requirements. By contrast, commercial manufacturers generally produce a high volume of goods to meet market demands, taking into consideration the reliability and affordability of the products (Brandt, 1994). It is obvious that a company set up to meet government regulations for military hardware is not going to be competitive in commercial markets without significant changes.

The overall corporate culture in defence firms is very different from that of commercial companies. This poses many problems when switching from defence to commercial production. The main areas of difficulty are as follows. The rigid and defined military specifications (milspecs) and military standards, imposed on both the product as well as the processes of production, often yield products that cost significantly more than their commercial counterparts (Brandt, 1994).

Unlike commercial firms which measure product cycles in years or even months, military product cycles are often measured in decades, and stress low rather than high production rates. Consequently, shifting from military to more modest commercial ones is often difficult (Centre for Economic Conversion, 1995).

Another major obstacle is the nature of the customer in the commercial market. Defence firms had a single customer focus where technical performance is valued more than cost competitiveness. Heavily defence oriented firms, therefore, are likely to have little familiarity or expertise in the commercial markets. This is likely the one most difficult problem facing defence firms.

The unique accounting and auditing requirements are also very different and not compatible with modern commercial accounting. There also exists certain government claims on technical data rights which prohibits commercialization.

When dealing with defence firms, their ways of working, practices, and company culture are difficult to change swiftly. This prevents the firms from being flexible, adaptable, and entrepreneurial, and consequently, from being able to easily redeploy their assets for civilian use (Anand & Singh, 1997).

Finally, many defence products have no commercial applications. This prevents those firms from doing anything other than their defence work unless they pursue totally unrelated markets.

As mentioned earlier, there are many examples of defence firms which have suffered dramatic losses and setbacks due to unwise diversification decisions. These failures serve as a potent reminder of what can happen to defence contractors that are used to dealing with one customer when they attempt to switch their focus from the military to the commercial market (Brandt, 1994).

"Although most captive defence suppliers lack the marketing expertise and cost efficiency to compete outside their home market, they are nonetheless heading off in a variety of directions. Favorite destinations include the defence agencies of foreign governments, non-DOD U.S. government agencies such as NASA and the Department of Energy, and commercial markets" (Burrows, 1992).

As if the conditions under which the defence companies must fight to survive were not hard enough, there are other obstacles standing in their way, such as the world-wide recession. Also, continued business for contractors from their existing customers is not guaranteed as many 'primes' are turning to vertical integration meaning less sub-contracting work (Burrows, 1992).

Defence firms clearly have many barriers to overcome if they are to successfully diversify out of the shrinking defence industry. It would seem that defence firms have to overcome a large initial handicap before they can begin competing and that any firm

moving from defence to civil applications has to cope with two degrees of culture change if it wishes to succeed (Smith & Smith, 1992).

However, as seen by the examples, successful conversion is possible if done properly. Defence firms will have to make a number of changes in order to deal with the differences in the two markets, but they are surmountable.

New skills will have to be learned, not only by the employees but by all of management. There will have to be a total reorientation of the attitudes and the focus within the company. Commercial markets require a drastically different perspective than one military government department. One of the most important factors for success is total management commitment to the changes. Management will also have to keep the defence and commercial production separate to satisfy the differing requirements, but there should also be a smooth transfer of the technology between the two divisions. Flexibility is very important and must be adopted instead of the rigid military production system. Finally, the key to successfully penetrate the commercial market is solid market research and effective marketing. Defence firms severely lack this ability. Consequently, many companies are entering into partnerships with other firms in order to capitalize on their abilities in marketing. Many firms are simply acquiring the businesses with the necessary competencies. Another method to deal with the problem of selling to commercial markets is to keep selling to the government, just pursue foreign governments instead. Hughes Aircraft is doing just that as it is selling their commercial air traffic control systems to foreign and domestic governments, something they know how to do (Watson, 1992).

Although there are many obstacles standing in the way of defence firms wishing to go commercial, these barriers can be overcome with proper strategic planning and persistence. There are many success stories and there will be many more. Besides,

there are not many other choices for some of these firms in today's defence industry. (Kennedy, 1990)

2.2.4 Globalization

One other strategy which has been considered by many defence companies is the idea of globalization. A number of firms are maintaining a defence focus and are attempting to increase sales through globalization by selling their products abroad. However, this strategy has many difficulties and will not likely be successful for most companies taking this route. The demand for military products is declining world-wide and, consequently, there are few opportunities for growth as foreign producers are also faced with excess capacity (Lundquist, 1992)

Attempts to sell to foreign defence agencies will most likely be unsuccessful as many governments are dealing with cutbacks themselves and while there are some nations which are not (Saudi Arabia, Korea, Japan), federal export regulations limit or even prohibit many potential sales.

Ratheon, however, is one of the few success stories from those pursuing this strategy. They plan to have 40% of their sales from global markets, mainly on sales of their Patriot missile in the Mid-East (Dial & Murphy, 1995). Due to the lack of potential which globalization offers most defence firms, discussion of this strategy is limited to the literature review section.

2.3 Canadian Content

Most of the existing literature is American based and therefore, deals with only American companies. Although the cutbacks in the United States are paralleling those

being experienced in Canada and the strategies being adopted are the same, this section considers the on-going restructuring from a Canadian perspective.

Five years ago, Canada's Department of National Defence (DND) spent \$12 billion a year, but that level has been declining ever since and in 1998-99, only \$9.3 billion is to be spent. In response to these cutbacks, Canadian companies are pursuing the very same restructuring strategies as discussed in previous sections.

Downsizing, as in any industry under budget constraints, is a popular strategy among Canadian companies. A controversial business strategy with mixed results as well as varying levels of success, it will however always be a widely used action for firms faced with cutbacks.

As in the United States, Consolidation is a popular strategy being used by a significant number of Canadian defence companies. Many companies are simply getting together in order to gain an edge over the competition for government contracts. This is evident when considering the team which consolidated in hopes of winning the contract to put together the mission systems for the new military helicopter. The team, which consists of Lockheed Martin, Computing Devices Canada, MacDonald Dettwiler & Associates, Canadian Marconi Co., Litton Systems Canada and IMP Group, is hoping the government will want to avoid the delay and expense of a competition, and will sole-source the contract to the Lockheed team. (Hobson, 1998)

Clearly there are those in favor of diversifying, such as Mr. MacIsaac at GasTOPS who stated that "it's diversify or die", but there are also companies such as Excalibur Systems Ltd. and DY 4 who continue to rely almost exclusively on military business. (Ray, 1998) Defence business may be shrinking for manufacturers of some of the larger military items, such as submarines and aircraft but there still exists a significant market for certain niche companies. It is a fact that the defence industry is a

declining market “but to say that all opportunities are gone is a myth, defence is still a huge budget line item”, states Gordon Frosst, president of Excalibur Systems. Excalibur has no plans to commercialize its technology, as the company would suffer a loss of focus. “There is no commercial application of this technology. We are good at what we do, so the trick is not to sell to the commercial market.” (Ray, 1998) This is a good example of how a company’s technology, and therefore their products, do not permit an easy transfer into commercial markets.

Although some companies have found niches within the military and continue to rely on defence contracts for the bulk of their revenues, diversification seems to be the key thrust for both large and small defence companies. Computing Devices, one of the largest defence companies, is now developing digital voting systems and computer technology that can diagnose patients in remote locations. Norm Smythe, president of Thomson-CSF Systems, points out that since “military budgets around the world have been cut by 25-50%, business has dried up.” Now, “everybody is looking for different markets, and we are no different.” (Ray, 1998) Only three years ago, Thomson-CSF relied on the military for 90% of its business, compared with only 50% today. They are just one of many companies following such a strategy. “We have less reliance on DND and more on commercial/industrial products,” states John Croft, Prior Data Sciences’ defence business consultant. Diversification has also been an on-going strategy at Canadian Marconi and their company’s product mix has moved from 80% defence/20% commercial to an even split. (Ray, 1998)

The key for these companies is that they are not simply pursuing other markets, rather, they are using their existing capabilities for commercial products. “Worldwide, the trend is the same. Defence budgets are decreasing. So CDC is trying to spin off its military experience and expertise into commercial products,” states Robert Fischer,

Computing Devices Canada (CDC) vice-president. (Hobson, 1998) Norm Smythe agrees with this strategy as Thomson-CSF is using the same core technology competence for paramilitary projects and they hope to commercialize technology developed through its work with the Canadian Navy. As has been learned the hard way for many firms, "you should not stray too far from your area of expertise. You should capitalize on your existing skills in a market that is similar but not too radically different, where you can use the same engineers and the smarts you have developed over the years." (Ray, 1998) DEW Engineering was, at one time, primarily a provider of defence goods and services. Today, however, their product line includes many non-military products and it has paid off. "It is not in our interest to stand still and rely solely on military work," states Wally Roueche, president of DEW Engineering. They plan to continue to diversify from their current 80% military business down to a 20% level over the next 7 years. (Ray, 1998)

Although not strongly considered in this study, globalization is becoming an increasingly important strategy for many defence-oriented companies fighting to remain competitive. In a bid to increase their business, they are beefing up their marketing departments and establishing a sales presence in overseas and U.S. markets. Excalibur Systems is just one of the firms ensuring that the company and its products get maximum exposure in global markets. (Ray, 1998)

2.4 Factors

Many individual factors must be considered before pursuing any of the various strategies. Companies must, therefore, evaluate each of these factors with respect to their particular operations before deciding on a course of action. From past literature, the following factors were expected to be the most influential.

The size of the company (**Company Size**) is one of the factors that was predicted to influence strategic decisions. It is clear that the actions taken by large billion dollar companies (such as the 'primes') are not the same as those of smaller, less stable, firms. As such, it was predicted that the overall size of the company would have a significant influence on the strategy(s) which was chosen.

As with company size, **Company Age** was expected to influence the selection of a strategy. It was predicted that older defence firms with years of experience in the defence industry would take different actions than newer firms who lack this experience.

The types of products and services (**Product Class**) which a business produces/provides was also expected to play a major role in the selection of an appropriate strategy(s). Clearly there will be differences between the strategy pursued by a tank manufacturer versus a communications company. In an effort to gain some insight in this area the products/services of the various defence companies were organized into the following categories (Burrows, 1992; Lundquist, 1992; Mraz, 1993):

Aerospace	Software
Electronics	Hardware and Vehicles
Communications	Defence Services
Weapons	Other

Defence-Dependency is the amount of total sales which is directly related to the defence sector. A company's dependency on defence contracts was predicted to have a direct influence on the company's strategic response.

Corporate Culture is one of the most difficult factors to deal with for many defence firms. A company with a heavy defence culture has long product cycles, low production rates, and operates under very rigid military specifications. Civilian cultures are less rigid, faster paced, with higher production rates. The culture of the defence firm was predicted to have a significant influence on the selection of a strategy. (Nironen, 1995)

The **Restructuring Experience** and expertise of the defence firm was also predicted to have an influence on the strategic responses which are selected. For this study, restructuring experience involves a company's previous downsizing/diversification/consolidation activities as well as the expertise which is contained within the company to carry out any of the three strategies.

2.3.1 Relationships

By considering which area of the defence market, as well as the individual characteristics of the particular firm, managers can determine which strategy(s) will be optimal for their company. There have been some studies conducted into this area and certain observations have resulted. A few of the conclusions regarding the relationship of these factors to the various strategies are discussed below.

One key finding was that the likelihood of companies implementing diversification strategies increased with the **size of the firm** (Finch, 1994). Smaller companies, therefore, are less likely to be involved in diversification in response to defence sector restructuring. These small companies can hardly downsize all that much and often turn to consolidation to survive during these downturns. Based on the research it was predicted that the smaller sub-contractors with significant defence work will turn to consolidation in response to the defence cutbacks (Mraz, 1993).

There have been few previous correlations found involving **company age** and it was predicted that the interaction between age and company size would more accurately reflect any connections with strategies (Finch, 1994).

The **type of product/process**, or area of the defence market for that matter, was predicted to greatly influence the decision to pursue a conversion strategy. Firms which are in the business of making strictly defence products, such as tanks, machine guns, etc., will find it very difficult to find commercial applications for these products. Those companies in the electronics or communications areas of the defence market have many more opportunities to diversify through the conversion of their products into commercial applications (Aeroe, 1993; Sandler, 1992; Curran, 1992)

It had also been found that there is a strong correlation between the **amount of defence dependency** of a firm and the particular strategy they elect to pursue. Firms with a high degree of dependence have basically followed an acquisition or consolidation strategy whereas those with lower levels of dependence have tended to diversify or divest (see Figure 2). As shown in the figure, those firms which rely heavily on government defence contracts will attempt to increase their chance of receiving the contract by reducing the number of competitors. For those firms which fall into the middle category (25%-65%), it is more ambiguous as to which direction the company will head. Firms which have a relatively low percentage of defence work will attempt to eliminate their defence operations or diversify in order to offset potential losses. In other words, the more dependent a firm is on the defence industry, the more likely it will remain principally a defence company.

A strictly defence oriented **culture** was predicted to impede the possibility of diversification or conversion. Prime Contractors, usually heavily defence-dependent, have a strong defence culture throughout the company. These firms have a much

more difficult time attempting to diversify due to the number of differences they encounter between the defence and commercial markets. A heavy defence culture is often a barrier to exit for many defence firms (Finch, 1994).

Companies with previous **restructuring** (diversification, downsizing, consolidation) **experience** were expected to be more likely to pursue such a strategy again (Finch, 1994). Those companies with the necessary expertise and past experience were thought to be better suited, and thus more likely, to take this approach than those without the skills and knowledge of what is required.

The optimal strategy(s) for a defence company in these times of restructuring will differ from one firm to the next. These strategies will depend on the various factors which characterize each individual firm. Careful analysis by managers is essential when deciding on a course of action. There is never an obvious choice but with effective strategic planning most firms can overcome the cutbacks being experienced throughout the defence industry.

Figure 2 U.S. Defence Industry Structure

Source: Mr. David M. Koonce, Martin Marietta Corporation.

(Brandt, 1994)³

³ Divest/Diversify represents: exit the defence market, selectively divest, shrink the business, and diversification.

Acquire/Consolidate represents: invest and grow the defence business, make acquisitions in defence, and merge with a competitor.

3. THE DEFENCE SECTOR RESTRUCTURING MODEL

Managers that are facing critical decisions regarding which direction their businesses should head, must first consider their individual company attributes. As seen in the **proposed** defence sector restructuring model (see Figure 3), a number of factors must be considered together in order to determine which strategy(s) will be of most benefit to a particular firm. This model is essentially composed of two sets of variables. First, it contains a list of factors which were predicted to influence a company's strategic response to the restructuring taking place within the defence sector. Second, it includes the various strategies which a defence firm could pursue in order to deal with these changes. It was hypothesized that the 6 factors shown in the model, or more precisely, the attributes which each firm possesses with respect to these factors, would have a direct impact on determining the optimal strategic response for the individual company. Also included in the model are the various methods available to companies to achieve a particular strategy.

It should be noted that very little empirical research exists in this area and no well proposed model has been put forth as of yet.

By understanding which strategies have historically been successful for other defence firms given a particular set of attributes, a manager will be provided with some direction for their own company. Ideally, managers facing such decisions today will benefit from other companies' past mistakes and avoid costly errors in an increasingly competitive industry.

Figure 3 PROPOSED DEFENCE SECTOR RESTRUCTURING MODEL

4. RESEARCH OBJECTIVE

A review of the relevant literature in this area prompted the following research objective:

To identify the significant factors influencing a company's strategic response to changes in the defence market.

5. RESEARCH METHODOLOGY

This study investigated the factors which influence a company's defence strategy. Correlations have been drawn between various sets of company attributes and the different strategies. This section will describe the steps that were undertaken in conducting this study. It is divided into four sub-sections. The first sub-section specifies the research design; the second details the sampling design; the third provides an account of the data collection method; and the last sub-section explains the analysis that was performed on the data.

5.1 Research Design

The research has looked into the various factors which influence a company's response to the changes taking place in the defence industry, as well as, the actual strategies themselves. The study used a primary data collection method and was carried out using questionnaires to obtain the required information.

5.2 Sampling Design

The sample included defence companies from across Canada in various defence sectors. The firms were of varying sales volume and size. The population size is approximately 300 companies and in order to acquire a sufficient response rate the survey was sent to the entire population.

5.3 Data Collection Method

The data for this study was collected using questionnaires. These were mailed and faxed to the senior managers or vice-presidents of the various defence firms. The questionnaire was constructed using past literature as well as information gathered through interviews with a few defence firm managers. Also, a pre-test was conducted with two defence firms in order to test the validity of the research instrument. Some of the comments from the first pre-test included; clarification of the strategic actions, an improved and more effective scale, the elimination of certain bias problems, and a clarification of the time frame within which this study is conducted. The second pre-test was helpful in establishing a comprehensive list of defence companies to which the survey could be distributed. The list was obtained from the Canadian Defence Industries Association (CDIA, 1998). Also resulting from the second meeting were suggestions regarding; the reworking of the culture question, the clarification of certain other questions, and a few changes to the different product classifications.

A high response rate was critical due to the relatively small number of firms and the data analysis method that was used. As such, many of the techniques available to obtain higher response rates were used in order to ensure valid and reliable results. These techniques included pre-distribution phone calls to over 100 companies, follow-up phone calls, e-mails, and the redistribution of the survey to those which did not respond. A cover letter was also included which outlined the goal of the study as well as the importance of the respondent's participation. A sample of the cover letter can be seen in Appendix 2.

5.3.1 Questionnaire Design

The questionnaire used in this study consisted of three parts and a copy can be seen in Appendix 3.

Part 1 dealt with the various strategies available to the defence companies to cope with the cutbacks. This series of questions provided data on which strategy was chosen as well as the amount of success achieved by the company since the strategic action was undertaken. This section also provided information on which company attributes were affected by the use of the strategic action as well as how the company responded in a number of key operating areas (i.e. revenue).

Part 2 provided detailed information on each company, with respect to the various factors, **before** the company pursued any strategic actions.

Part 3 provided information on the same company characteristics (factors) but **after** any strategic actions were undertaken.

By comparing the company factors before and after they pursued a particular strategy, the **effects** of the strategic response(s) can be determined and analyzed. Many questions are descriptive in nature or involve the selection of one or more choices from a number of options. However, several questions involve the use of a scale in order to achieve a quantitative response.

5.4 Data Analysis

The three different strategies that have been focused on in this study can be separated and analyzed in three separate regression equations. Since each of the strategies is binomial, the data have been analyzed using logistic regression. What distinguishes a logistic regression model from the linear regression model is that the outcome variable in a logistic regression is **binary** or **dichotomous**. Here, the dependent (y) variable is not normally distributed, but is binary (having a value of either 1 or 0) with a conditional binomial distribution (Hosmer & Lemeshow, 1989; Stevens, 1996). In this study there are three different dependent variables; Diversification, Consolidation, and Downsizing. As such, there were three separate logistic regressions where each y variable (the different strategies) was treated separately in order to draw conclusions. Each dependent variable received a value of “1” if any of the various methods for pursuing a particular strategy (as shown in the model) is selected. For example, if a firm has sold off a business division (sell-off) in order to deal with the defence cutbacks, that company will be considered to be following a downsizing strategy and receive a value of “1” for that dependent variable. The regressions in this study each involve more than one independent variable.

The independent variables in this study are the various factors which were predicted to influence the selection of a strategy in response to the defence cutbacks. These factors were as follows: Company Size, Company Age, Product Class, Defence-Dependency, Corporate Culture, and the Restructuring Experience at the company for the respective strategy.

Firms were permitted to select more than one strategy and thus they can be included in more than one of the three logistic regression equations as having a value of “1”. As such, the estimated logistic regressions are correlated, i.e. the sets of

estimated logistic regression coefficients (the betas) are correlated across the three equations. However, in this study the interest is focused on the interpretation of the betas in each equation (i.e. each strategy), as a unit, rather than as a comparison of the betas across the three equations. Therefore, correlations between the strategies, revealed through a seemingly unrelated regression (SUR) analysis performed using the Statistical Analysis System (SAS) software package, will be interesting to note but not influential on the conclusions drawn from the three equations. The actual analysis that evaluates the effect of the independent variables on the strategies (the dependent variables) was based on three separate logistic regressions.

6. RESULTS

The objective of the study was to identify the significant factors influencing a company's strategic response(s) to changes in the defence market. This section will discuss the results obtained from the country-wide survey and present the conclusions.

By using the techniques to achieve a high response rate (discussed in section 5.3), a substantial number of responses were obtained. Certain respondents were not included in the analysis for various reasons. For example, some companies were omitted due to their extremely small size and other companies were found to be detrimental to the analysis, i.e., had a size and scope of operations which led them to be an outlier and threw off the accuracy of the results. A total of 5 companies were dropped from the data set. A complete list of the respondents included in the analysis is provided in Appendix 4.

6.1 Output Results

The data, collected through a country-wide survey of defence firms, was entered into the Statistical Package for Social Sciences (SPSS) due to its ease of use and data sorting abilities (Keller, 1990). The data was then converted to a usable Statistical Analysis System (SAS) format for running the analysis (SAS Institute Inc., 1996; Timm & Mieczkowski, 1997). The complete data analysis method is detailed in Appendix 5.

Logistic regressions were used to analyze the survey data. A summary of the output results can be found in Appendix 6. Each of the three regressions were found to be significant (see Table 2) and they all demonstrated a fairly high R-squared (see Appendix 7). A brief summary of the significant data for each equation is outlined below in Tables 3, 4, and 5.

Table 2 Significance of the Three Regression Models

Model	Significance
Downsizing	0.0001
Consolidation	0.0001
Diversification	0.0363

Each of the models demonstrates that they are significant at the 0.05 (5%) level, the level used for all the analysis in this study. This indicates that conclusions can be made which are statistically supported.

Table 3 Significance of the Variables in the Downsizing Model

Variable	Betas	Significance	Odds Ratio
Logempa	0.5764	0.0190*	1.780
Agea	0.0394	0.0391*	1.040
Classa	0.0681	0.8711	1.070
Percenta	0.0186	0.2136	1.019
Perprima	-0.0129	0.1632	0.987
Culturea	0.2997	0.3520	1.349
Expera1	-0.0920	0.7820	0.912
Experta1	0.3922	0.2077	1.480

*** Significant at the p = .05 level**

When considering the Downsizing strategy, the **Size** of the company and the **Age** of the company variables were found to be significant. As such, these variables are influential in the decision to pursue such a strategy.

The resulting equation is:

$$\begin{aligned} \text{Downsize: } g(x) = & -6.0311 + 0.5762(\text{Logempa}) + 0.0394(\text{Agea}) + 0.0186(\text{Percenta}) + \\ & 0.0681(\text{Classa}) - 0.0129(\text{Perprima}) + 0.2997(\text{Culturea}) - 0.0920(\text{Expera3}) + \\ & 0.3922(\text{Experta3}) \end{aligned}$$

Conclusions can be drawn regarding downsizing when considering the size of the company, which was found to be significant with an odds ratio of 1.78. This indicates that for a 1 unit change in the log size of the company, the company will be 1.78 times more likely to downsize. A complete explanation of the logistic regression equation and the odds ratio can be found in Appendix 8.

Table 4 Significance of the Variables in the Consolidation Model

Variable	Betas	Significance	Odds Ratio
Logempa	0.5210	0.0190*	1.684
Agea	-0.0097	0.5601	.990
Classa	0.4632	0.3249	1.589
Percenta	0.0184	0.1659	1.019
Perprima	-0.0033	0.7128	0.997
Culturea	0.4172	0.1877	1.518
Expera2	-0.4250	0.4187	0.654
Experta2	1.1840	0.0323*	3.267

* Significant at the $p = .05$ level

Table 4 shows that the significant variables for the Consolidation strategy are the **Size** of the company and the **Expertise** within the company for carrying out Consolidation related activities.

The resulting equation is:

$$\begin{aligned} \text{Consol: } g(x) = & -6.4303 + 0.5210(\text{Logempa}) - 0.0097(\text{Agea}) + 0.0184(\text{Percenta}) + \\ & 0.4632(\text{Classa}) - 0.0034(\text{Perprima}) + 0.4172(\text{Culturea}) - 0.4250(\text{Expera2}) + \\ & 1.1840(\text{Experta2}) \end{aligned}$$

The expertise of a company, proven to be significant with an odds ratio of 3.267, can be used to make conclusions regarding consolidation. As the in-house expertise regarding the consolidation strategy at a company increases by 1 unit on the measuring scale, the probability of the company pursuing consolidation increases by a factor of 3.27.

Table 5 Significance of the Variables in the Diversification Model

Variable	Betas	Significance	Odds Ratio
Logempa	-0.1457	0.4503	0.864
Agea	0.0113	0.4286	1.011
Classa	0.0829	0.8539	1.086
Percenta	0.0415	0.0140*	1.042
Perprima	-0.0052	0.5588	0.995
Culturea	-0.5550	0.1539	0.574
Expera3	-0.0301	0.9457	0.970
Experta3	-0.3278	0.4450	0.721

*** Significant at the p = .05 level**

The Diversification strategy was found to have only one significant variable, that being the percentage of the companies business activities which is strictly defence work (Defence Dependency).

The resulting equation is:

$$\begin{aligned} \text{Divers: } g(x) = & 2.1389 - 0.1457(\text{Logempa}) + 0.0113(\text{Agea}) + 0.0415(\text{Percenta}) + \\ & 0.0829(\text{Classa}) - 0.0052(\text{Perprima}) - 0.5550(\text{Cultura}) - 0.0301(\text{Expera1}) - \\ & 0.3278(\text{Experta1}) \end{aligned}$$

For diversification, a conclusion can be drawn with respect to the percentage of strictly defence work, significant with an odds ratio of 1.042, being done by the company. With an increase of 10% defence work, a company is 1.514 times more likely to attempt diversification (see Appendix 8 for computation).

A complete discussion of these results is found in section 7 - Findings and Conclusions.

6.2 Multiple Strategies

Many of the companies responding to the survey have used multiple strategies. The percentage of respondents using each of the strategies is shown in Graph 1.

Graph 1

A quick method to show the extent of multiple strategy usage is by using a double counting index (see Table 6). Here, the number of counts for each strategy as well as the total number of responses (companies) is considered. The total number of counts is divided by the number of companies to provide the intensity number. A perfect index (the highest intensity number) is equal to 3 and indicates that each company chose each of the strategies. An index of 1 on the other hand indicates that only one strategy per company was chosen.

Table 6 Double Counting Index for Multiple Strategy Usage

Diversification	Consolidation	Downsizing	Companies
56	43	33	75

$$\text{Intensity \#} = 56 + 43 + 33 / 75 = 132/75 = 1.76$$

Considering that five companies didn't pursue a strategy at all and the high intensity number (1.76), it is apparent that there was a significant number of companies using multiple strategies.

A multinomial table was also used, where each of the companies was fit into one of the eight cells in the table. A company was placed in a particular cell depending on which strategy(s) they chose. Table 7 shows the assorted different strategy combinations that were used.

Table 7 Response Distribution Reflecting Strategy Selection

		Consolidation				
		YES	YES	NO	NO	
		Downsizing				
		YES	NO	YES	NO	Total
Diversification	YES	19	14	7	16	56
	NO	5	5	2	7	19
	Total	24	19	9	23	75

The 19 in the top left column, for example, indicates that all three strategies have been pursued by 19 responding companies. A summary of the totals are as follows:

Graph 2

These statistics indicate that a fair number of companies (over half) are pursuing more than one strategy. As such, it would be expected that the three different regressions would be correlated to some degree. To deal with this issue, as mentioned in section 5.4, a seemingly unrelated regression (SUR) analysis has been performed in order to discover the degree of correlation which could exist between the three equations. A description of the SUR method of analysis can be found in Appendix 8. A SUR analysis, rather than a Generalized Least Squares, was appropriate for this study since the three equations have different independent variables. (Amemiya, 1985) There are six identical variables (Logempa, Agea, Classa, Percenta, Perprima, Culturea) and two distinct variables (Expera1, 2, or 3 and Experta1, 2, or 3) used only for the respective strategy. If each of the variables had been identical then a Generalized Least Squares (GLS) estimator would have been appropriate. The results of the SUR analysis indicate that there were no significant correlations between the three equations. Had there been a significant correlation then across equation comparisons would not have been possible and steps would need to be taken in order to address that issue. However, that is beyond the scope of the analysis for the purposes of this study. Appendix 9 provides the complete SUR analysis results.

As discussed earlier, the minor correlations between the equations have permitted the use of separate logistic regressions in order to obtain results and come up with conclusions.

Also included in the survey were choices between various methods for pursuing the selected strategy. The following charts indicate the numbers regarding the selected methods for the three strategies. Again, multiple selections were observed.

Chart 1 Methods to Pursue the Consolidation Strategy

The surveys indicate that the majority of respondents chose to form alliances in an effort to consolidate the defence industry as a response to the defence cutbacks. Due to the present overcrowding within the sector, alliances have become a popular method among larger firms in order to avoid the intense competition for the reduced defence work. Alliances, although requiring a significant amount of effort to be successful, are the least difficult and most common of the three methods.

Chart 2 Methods to Pursue the Diversification Strategy

This indicates that the majority of respondents chose to diversify through conversion as opposed to the other methods. Contrary to past literature (Scott, 1995; Markusen & Yudken, 1992; Mraz, 1993; Burrows, 1992; Alexander, 1990; Brandt, 1994; Anand & Singh, 1997), conversion seems to be increasingly popular and companies seem to be having a fairly high level of success. In the past, it was commonly thought that the conversion of defence products for commercial markets was too difficult due to a number of company characteristics. Nowadays, numbers indicate that the majority of companies are performing some degree of conversion activities.

Chart 3 Methods to Pursue the Downsizing Strategy

Layoffs were determined to be the most popular means of downsizing for most firms. This is not too much of a surprise given the fact that this method is the least drastic of the three. Although most companies reported some success in following a downsizing strategy, it was the least successful (see Table 8) of the three strategies and many companies didn't see any improvement overall improvement.

The various methods were not included in the three regressions as variables themselves, rather they were included as part of their respective dependent variable. However, it is interesting to note the numbers regarding the the selection of the various methods for each strategy.

7. FINDINGS AND CONCLUSIONS

As seen in Graph 1 (page 45), each of the three strategies was used by many of the defence companies as a means to deal with the cutbacks taking place within the industry. It was also very evident, however, that the majority of companies pursued some degree of diversification. The results show that 56 of the 75 respondents performed some sort of diversification activities. The level of success of the respondent companies, as reported on the surveys, has been relatively consistent between each of the strategies. It should be noted that this level of success was subjective and based on the judgement and perception of the individual respondents. Their success was measured on a five point scale and the averaged results are as follows:

Table 8 Strategy Success Levels

Strategy	Average
Consolidation	3.7
Diversification	3.8
Downsizing	3.5

The Downsizing strategy demonstrated the most inconsistency with many low as well as many high levels of success. On average it would seem to be the least successful of the three strategies. Of those companies surveyed, Diversification seems to be the most beneficial means for defence firms to cope with today's cutbacks. A look at the findings regarding the individual company factors is found below.

As mentioned earlier, four of the six factors expecting to have an influence on the selection of a strategy were in fact found to be significantly correlated. The other two were not significant in the output results but did show an observed correlation with the strategies. Each of the factors is discussed separately in the following paragraphs.

Company Size

It was found that there was a significant correlation between the size of a company and the selection of a strategy. As predicted, it was found that larger firms tended to follow a downsizing strategy. Results indicate most of the larger companies have downsized to some degree. Contrary to what was initially expected, consolidation was also popular among the larger firms as a means to deal with the cutbacks, although not to the degree downsizing was chosen. The high consolidation rate among large firms was mainly due to the formation of alliances in order to reduce the competition in the highly competitive and overcrowded defence sector.

Company Age

As hypothesized, company age was found to be significantly related to the selection of a strategy. As with company size, it was noticed that the older the company the more likely they were to downsize. Diversification seemed to be a strategy pursued by companies of all ages. In a correlation matrix, company age was found to be correlated with company size to some degree for diversification (.35) and consolidation (.32) but not substantially with downsizing (.18). As such, it may not be the best predictor on its own for the other two dependent variables (Consolidation and Diversification) but does demonstrate a significant correlation with the downsizing strategy.

Product Class

Although it was not quite found to be significant, the defence class within which a company was operating did show a certain correlation through an examination of the descriptive statistics and regression coefficients (see Appendix 6). Those companies with highly defence-dependent products were more likely to follow a downsizing or consolidation strategy. On the other hand, it was seen that those companies with products which were less defence-dependent and had commercial applications, often followed a diversification strategy. There are those companies which are in a position to diversify due to the nature of their products and then there are those firms which are presented with significant challenges if they wish to do so. As such, the nature of the products and services offered by a company, influences their selection of a particular strategy in order to deal with cutbacks in defence spending.

The product class was not proven to be significant in the data analysis. Possible explanations for this include an inappropriate measuring scale which did not lead to conclusive results. Either a lack of appropriate product class selections on the survey or the inappropriate placement of the companies when establishing the usable scaled version (explained in Appendix 6) could have caused such a problem. Other issues or product classes may have been overlooked which affected the results of this factor. Also, there simply may not be a significant correlation between the selection of a company's strategy and the product class. This may be due to the very low number of companies producing strictly defence related products.

Defence Dependency

The degree of defence work performed by a company was found to be influential in deciding on a strategic action. Contrary to the hypothesis, those firms with a high defence-dependency were more likely to attempt diversification. However, it is evident that diversification is becoming an increasingly popular strategy for firms doing all levels of defence work. Although firms which are already doing some commercial work have a much easier time when attempting to move further into non-military markets, those firms with a high level of defence-dependency are currently pursuing such a strategy themselves regardless of the barriers which they must overcome. This was confirmed recently by Thomson-CSF and Canadian Marconi when they announced publicly that they had both gone from 90% and 80% respectively, down to 50% defence work. This was also supported by Prior Data Sciences and DEW Engineering. In an effort to remain at current business levels, such companies are having to look to other markets in light of the cutbacks to their primary market.

Corporate Culture

The culture of the defence company was not found to be statistically significant in the selection of a strategy. However, upon inspection of the descriptive statistics, it was found that the firms with the lowest defence culture were more likely to diversify into commercial markets. This would lead one to believe that those companies which have high defence company cultures are less willing or able to break away from their usual work environment and embrace a completely new way of working. Although not found to be statistically significant, the descriptive statistics do seem to support the hypothesis. This would indicate that firms which have strictly defence cultures will remain as defence companies, whereas those who have commercial market

experience, and therefore to some degree a commercial culture, will shift further into such markets as a response to the cutbacks.

The lack of a significant result from the data analysis may indicate that there was some ambiguity in the wording of the question which potentially led respondents to incorrectly answer this question. Other influential factors or a segregated company culture could also throw off the output for this variable and lead to a non-significant result. It may also be the case that there indeed does not exist a correlation between the strategy chosen by a company and the corporate culture.

Restructuring Experience

The restructuring experience factor was proven to be a significant variable also. As predicted, those companies with the in-house expertise regarding consolidation were more likely to take such a course of action. Essentially, those companies already involved with consolidation in the past were more willing and able to pursue the same strategy again because of their previous experience and knowledge. Diversification, due to the large number of companies attempting this strategy, did not have any correlation with experience or expertise as companies are moving into non-military markets regardless of their backgrounds.

Overview

Relating back to the proposed defence sector restructuring model, Figure 4 presents the updated version based on the findings obtained in this study. The model displays the four factors which were found to be significant as well as two factors showing a weak correlation with the three strategies. Essentially, the Company Culture and the Product Class variables showed a certain correlation but were not found to be statistically significant variables in the regression analysis (explained in detail in section 6 - Results).

The various methods available for carrying out the three strategies, which were utilized by the respondents, are also shown. Those not selected were omitted.

It would seem that the best course of action for companies already doing commercial work is to use their expertise and experience they've gained and pursue other related markets in order to maintain their level of business activity in light of the still declining defence market. Those companies which have the experience with commercial markets will be at an advantage. Those heavily defence dependant companies will have a harder time adapting to the commercial market characteristics. Culture and a lack of knowledge in this area will be a deterrent but it is not impossible to diversify successfully as seen by the many companies who have already taken such steps. It is essential to focus on core competencies and not stray too far from what the company is experienced at. Of those companies that are diversifying, the method of conversion seems to be a popular selection. Over one in three companies (28 of 75 respondents) are converting their technology and expertise and focusing it on the commercial market. A successful conversion strategy begins with full management commitment to the move into commercial markets using the expertise and technology from defence products.

DEFENCE SECTOR RESTRUCTURING MODEL

Figure 4

FACTORS:

STRATEGIES:

METHODS:

Index for Figure 4

Represents significant factors
Represents an observed influence
Represents normal links

In this period of reduced defence spending, consolidation would seem to be a necessary means for those highly defence dependent firms to eliminate excess companies and divisions from the overcrowded defence sector. As managers realize that not all existing defence companies will be able to compete effectively for the diminishing defence budget, there will be more sell-offs of divisions, mergers, and alliances in order to remain competitive.

Downsizing will continue to be a popular method of dealing with a declining business no matter what name you call it by. This strategy is most useful for the larger firms with excess employees, unproductive departments, etc. However, a quick fix is not always the best answer and it is a lot harder to turn around a troubled company with half the resources.

As an example, consider two separate defence companies with the following characteristics:

Company A	Company B
1000 employees	20 employees
40 years old	5 years old
Produces military aircraft and vehicle parts	Produces electronic and software systems
A mostly defence culture	A mostly commercial culture
80% defence work	25% defence work
Some experience in alliances and downsizing	Some experience in pursuing other markets

It would be expected that company A would initially attempt to consolidate or diversify when faced with significant defence cutbacks. There is also the probability that the company will downsize to some degree. Alternatively, it would be expected that company B would simply diversify into other markets in order to maintain a high level of sales. The probabilities* for the two companies to pursue the different strategies, according to the logistic equations, are as follows:

<i>Company A</i>		<i>Company B</i>	
Consolidation	88%	Consolidation	6%
Diversification	94%	Diversification	54%
Downsizing	58%	Downsizing	1%

* Probabilities calculated using equations from Appendix 8 and based on 80% prime contract work.

Although this is what the results from the research indicates, it does not mean that these are always the appropriate strategies. Those companies surveyed, however, did indicate a fairly high level of success in adopting their particular strategies. One key finding was that diversification was found to be the most popular strategy. As such, most companies, as long as their products or services permit, should consider looking into other markets for commercial uses for their products and technologies. However, it is important to pursue markets which are closely related with existing products and capabilities.

Defence firm managers are faced with many tough decisions and choices regarding the company's future when attempting to handle the present defence sector restructuring. What is best for one company is not necessarily the ideal strategy for another. Many individual company characteristics must be considered when making these decisions. In light of the pessimistic state of the defence sector, these decisions will continue to trouble managers for some time yet.

8. BENEFITS OF THE STUDY

This study provides a look at how defence companies across Canada have been responding to the cutbacks taking place throughout the defence sector. It also details which factors have been found to be significant in the selection of one of the various strategies. This enhances the understanding of what is taking place in the defence sector and why it is happening. Defence firm managers can benefit from this information when deciding on a course of action for their company. Conclusions have been drawn in an effort to provide some direction for managers of defence companies faced with these cutbacks. By understanding what other companies are doing and how they are making out, decisions regarding the next strategic action can be made with more knowledge and support than previous ones. With greater information, managers and decision makers will consider other possibilities (otherwise not considered) for their company's future. Essentially, managers will benefit from this historical data and they can be more confident in their present decision, once determined.

This study also provides a basis for future research into this area. This research has taken a "macro" view of the selection of a strategy. It would be interesting to study each of these selections in more detail and arrive at certain conclusions for the strategies individually.

Other factors or moderators not included in this research could have played an influential role in the strategy selections. A company's corporate structure could be considered in some detail as it may be influential to the selection process. Also, a company's research and development (R&D) expenditures could prove to be a significant factor in the selection of a strategic response. The consideration of other factors or moderators would make for a useful expansion of the present study.

Although touched upon in the study, the Prime versus Sub-contractor issue could be analyzed in more detail. The possible inclusion of this factor in the model or the use of separate data sets (one for prime, one for sub-contractors) could prove to be a valuable addition to the present research.

A more in-depth look at the success of the various actions that were taken could be very informative. Although the success of these strategies was considered in this study to some degree, there was not a large focus on the individual success levels and possible correlations.

It is interesting to note the various methods selected in order to carry out the desired strategy. This might also provide a possible topic for future research. Touched on in this study, a more comprehensive look at these methods, especially conversion, could be a valuable addition to the existing literature.

A look into alternative strategies or actions may also prove to be a useful study. Globalization, for example, could be investigated and studied to a much greater extent than in the present research.

A comparison between the actions taken by defence firms and commercial companies in declining industries would also be an interesting study.

Finally, the validation of the existing model would be an interesting project. This could be approached using two methods. First, the collection of further data could be used to test the present model. This could also be done by separating the present data and using some part of the sample for conclusions, then use the balance to test the model.

Ultimately, when used as a foundation, many other informative and beneficial studies could originate from this research.

9. LIMITATIONS OF THE STUDY

Time and budgetary constraints limited the sample size used in the study to a certain degree. Also, due to the fact that this study was dealing with only Canadian defence firms, it provided a limited overall sample. Every possible step was taken in order to receive a significant number of responses to the survey. Ultimately, an adequate number of responses were obtained to reach valid and reliable results.

The fact that certain companies are pursuing more than one strategy at a time could be an issue for across equation comparisons, due to correlations between the various strategies. If that were the goal of this study, more attention would have been given to these correlations. However, the SUR analysis revealed that dealing with these correlations would not be a significant task for this data set.

In completing the survey, there was always the potential for respondent bias as well as the possibility of response errors stemming from the interpretation of certain questions. However, through the wording and structure of the questionnaire most of the potential for such errors was eliminated.

Though the reliability of the study was tested through a rigorous literature review and pre-tests, it is possible that additional factors exist that are important to the selection of a strategic response that have not been captured by the research. Along the same line, alternative strategies may have been overlooked in this study.

Also, the use of the present model as a predictive tool will need the validation of the model with other data. Presently, the Defence Sector Restructuring Model has not been tested with existing data due to the relatively small sample size.

Finally, the results obtained in the present study are not generalizable to the entire defence sector due to the high non-response rate of defence companies (70%).

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Appendix 1

Fall-Out Effects

M1-A2 Tank Cutback Does Industry Damage

Here is some expected fall-out if the U.S. government reduced procurement from 8,000 to 63 as planned.

The prime contractor: The land systems division of \$8 billion General Dynamics will not dole out the \$3 to \$5 billion in contracts it had planned to award over the next 8-10 years.

The sub-contractor: \$150 million-plus Smith Industries, which builds the M1-A2's position navigation system, will lay off 10% of its workforce and eat 50% of its R&D costs on the tank program.

The services company: \$25 million contract manufacturer Lau Technologies will not build the mil-spec circuit boards that bring in almost half of its sales, and will layoff half of its 200 employees.

The components supplier: \$10 million hybrid IC maker White Technology will lose half of its sales as well, and will layoff 25% of its 120 employees.

(Burrows, 1992)

Appendix 2

Cover Letter

October 1, 1998

School of Business
Faculty of Public Affairs and Management
Duntun Tower
1125 Colonel By Drive
Ottawa, ON K1S 5B6 Canada
Tel: (613) 520-2388
Fax: (613) 520-2532 or (613) 520-4427

**A Study of
*Canadian Defense Companies***

Dear Sir or Madam:

I am presently conducting a study on the impact of changes in the defense market (mainly cutbacks in defense spending) on Canadian defense companies, as well as those companies dealing with defense products and services. This is part of my Master of Management Studies degree at Carleton University. This survey is designed to identify the factors influencing a company's strategic response to changes in the defense market. Your participation will help in understanding the strategies which defense firms undertake in response to changes in today's market, specifically the defense cuts, given their individual company characteristics. Conclusions will be drawn from the empirical evidence collected in an effort to provide useful information for companies like yours.

Your cooperation in this study will be very helpful to my research. It will take approximately 15 minutes to complete the survey. All information provided will be kept completely confidential. My interest lies in the aggregate results of the research and not in the specific facts of particular companies.

Thank you in advance for your assistance in this research. If necessary, I can be reached at (613) 226-8029.

Sincerely yours,

A handwritten signature in cursive script that reads "Jason Weatherbie".

Jason Weatherbie, B. Comm.

Appendix 3

Questionnaire

Research Centre for Technology Management
Carleton University
School of Business

A Study of
Canadian Defense Companies

Overview and Instructions

1. This survey is designed to identify the factors influencing a company's strategic response to changes in the defense market. Your participation will help in understanding the strategies which defense firms undertake in response to changes in today's market, specifically the defense cuts, given their individual company characteristics. There is no right or wrong answer. Rather, your experience will provide valuable insight.
2. All information given in this survey will be kept in the strictest confidence and will only be presented in the research results in aggregate form.
3. All information pertains to the reporting firm. It is not expected that all information exists in a convenient form - please do not hesitate to estimate.
4. Please answer all the questions and return the questionnaire to the enclosed address or fax it to Vinod Kumar (613-520-2532) as soon as possible.
5. If you have any questions about this survey, please contact Vinod Kumar at the School of Business, Carleton University, Ottawa, Ontario, K1S 5B6, phone: (613) 520-2379; fax: (613) 520-2532; e-mail: vkumar@ccs.carleton.ca
6. If you would like a summary of the results of this study sent to you, please indicate this in the space provided at the end of the questionnaire.

THANK YOU FOR YOUR ASSISTANCE IN THIS RESEARCH

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PART 1. Strategic responses in terms of *Downsizing, Consolidation and Diversification* to deal with the defense cuts

1. The cuts in Canadian defense expenditures in early 1990's have forced most defense firms to adjust their strategies. For each question, please indicate which action(s) your firm has undertaken **over the past 5 years** in response to the defence cuts. Please *check* the appropriate response(s).

Consolidation¹ actions (focus is on intensification of existing capabilities and markets by bringing together companies)

Alliances	☐	Other (please specify and explain) _____
Acquisitions	☐	_____
Mergers	☐	None ☐

Diversification² actions (focus is on the reduction of a company's dependence on defense)

Alliances	☐	Other (please specify and explain) _____
Acquisitions	☐	_____
Mergers	☐	Conversion ³ ☐ None ☐

Downsizing actions

Layoffs	☐	Other (please specify and explain) _____
Divesting:		_____
Sell-Offs	☐	
Spin-Offs	☐	None ☐
Plant Closures	☐	

2. To what extent do you consider your efforts to be successful in countering the impact of defence cutbacks (please circle the appropriate response).

Not successful at all

Extremely successful

1

2

3

4

5

¹ Consolidation is an intensification of focus on existing capabilities and markets by bringing together companies in a fashion which builds critical mass, reduces overhead through economies of scale, enables sharing of technology, and builds premiere organizations which can compete effectively.

² Diversification is defined as the reduction of a company's dependence on defense by acquisition or organic growth of *non-defense* operations.

³ Conversion can be broadly defined as a shift from military to civil production through the adoption of the existing military technology, capital, and skills base - an organic growth into new product areas and new markets.

3. To what extent, on a scale of –3 to +3, were the following attributes of your company affected by the strategic action(s) undertaken (refer to question #1), -3 represents a significant decrease and +3 represents a significant increase.

	Significantly decreased			No change		Significantly increased	
revenue	-3	-2	-1	0	1	2	3
operational costs	-3	-2	-1	0	1	2	3
focus on core competencies	-3	-2	-1	0	1	2	3
knowledge/skill level of workforce	-3	-2	-1	0	1	2	3
market share in key business	-3	-2	-1	0	1	2	3
Other (please list)	-3	-2	-1	0	1	2	3

4. In your perception, to what extent have the following factors influenced the success of the strategic actions? - 1 represents a negative influence, 0 represents no influence, and the scale from 1 to 5 represents the extent of positive influence from very small to quite significant.

	Negative influence	No influence	Somewhat influence		Significant positive influence		Not Applicable	
Management commitment to change	-1	0	1	2	3	4	5	N/A
Labour participation in selecting civilian products/processes	-1	0	1	2	3	4	5	N/A
Strategic planning	-1	0	1	2	3	4	5	N/A
Ease of transfer of military products or underlying technologies to commercial markets	-1	0	1	2	3	4	5	N/A
Development or acquisition of commercial marketing expertise	-1	0	1	2	3	4	5	N/A
Flexibility in plans	-1	0	1	2	3	4	5	N/A
Corporate culture	-1	0	1	2	3	4	5	N/A
Other (please list)	-1	0	1	2	3	4	5	

In the next two sections we are asking a series of questions with respect to the characteristics of the company *before* and *after* any strategic actions were taken to deal with the defense cutbacks. PART 2 deals with before and PART 3 deals with after the situation.

PART 2: Please consider the situation "*before strategic actions were undertaken to respond to the defense cutbacks*" and answer the questions from that point in time.

1. What was the number of employees in your company? _____

2. How old was your company? _____ Years

3. What type of products/processes did your company manufacture/provide?

Aerospace	☐	Hardware & Vehicles	☐
Electronics	☐	Defense Services	☐
Communications	☐	Software	☐
Other (please specify)	☐	Weapons	☐

4. Please name some of the specific products or services your company manufactured/provided

5. What percentage of your sales was from defense contracts? _____ %

6. What were your competitive threats:

	No threat at all				Very serious threat
Competition based on price & cost	1	2	3	4	5
Competition based on product technology	1	2	3	4	5
Competition based on advertising/delivery speed/ product range/service after sales	1	2	3	4	5

7. With respect to your defense work, before undertaking any strategic actions would you classify your company as a prime contractor (dealing directly with the government), a sub-contractor (dealing with other contractors), or a combination of the two?

Prime Contractor ☐

Sub-Contractor ☐

Combination ☐ please specify the % of business as prime contractor ____ %

8. In firms with a **civilian culture**, business is typically less rigid, faster paced, and has high production rates. Firms with a **defense culture** typically have long product cycles, low production rates, and more rigid specifications. Please rate the type of culture in your firm, prior to any defense cutbacks, on a scale of 1 to 5. Circle the appropriate response.

Civilian Culture				Defense Culture
1	2	3	4	5

9. Rate on a scale of 1 to 5 your firm's *downsizing/ consolidation/ diversification* experience (please circle the appropriate experience), if any, prior to undertaking a strategic action to respond to defence cutbacks.

No previous experience					Substantial previous experience	
1	2	3	4	5		
					<i>Downsizing</i>	
1	2	3	4	5		
					<i>Consolidation</i>	
1	2	3	4	5		
					<i>Diversification</i>	

10. Please rate on a scale of 1 to 5, if the necessary *downsizing/ consolidation/ diversification* expertise (please circle the appropriate expertise) existed in your firm at the top management level, prior to undertaking a strategic action to respond to defence cutbacks or was outside help required.

No expertise					Substantial expertise	
1	2	3	4	5		
					<i>Downsizing</i>	
1	2	3	4	5		
					<i>Consolidation</i>	
1	2	3	4	5		
					<i>Diversification</i>	

PART 3: Please consider the situation "*at the present time*", following the selection and adoption of a strategic response.

1. What is the number of employees in your company? _____

2. How old is your company now? _____ Years

3. What type of products/processes does your company manufacture/provide?

Aerospace	☐	Hardware & Vehicles	☐
Electronics	☐	Defense Services	☐
Communications	☐	Software	☐
Other (please specify)	☐	Weapons	☐

4. Please name some of the specific products or services your company manufactures/ provides.

5. What percentage of your sales is from defense contracts? _____ %

6. At present would you classify your company as a prime contractor (dealing directly with the government), a sub-contractor (dealing with other contractors), or a combination of the two?

Prime Contractor	☐	
Sub-Contractor	☐	
Combination	☐	please specify the % of business as prime contractor ____ %

7. Please rate the company culture, at present, in your firm on a scale of 1 - 5 (*circle* the appropriate response).

Civilian Culture				Defense Culture
1	2	3	4	5

There exists a segregated culture between defense and commercial work ☐

Please print the name and telephone number of a person in your firm we might contact for further information if necessary.

Thank You for completing our questionnaire. Please provide below your address if you wish to receive a copy of the results of this study (or attach your business card).

Appendix 4

List of Respondents

List of Respondents

Acro Aerospace
Applied High Technology Corp.
Aircraft Appliances & Equipment Ltd.
AMCAN Technologies Inc.
Array Systems Computing Inc.
Atlantis Aerospace Corp.
Barrday Inc.
B C Instruments
Bell Helicopter Textron Canada
BG Technology Inc.
Bristol Aerospace Inc.
CAE Inc.
CANAM Aerospace Inc.
Canada Cordage Inc.
Canada Forgings Inc.
Canadian Marconi Company
Computing Devices Canada Ltd.
Contro Valve Equipment Inc.
CSI Aerospace
Deloitte & Touche Consulting
Devtek Corp.
Diamond Aircraft Industries Inc.
Diffracto Ltd.
DRS Flight Safety and Communications
English Plastics
EWA - Canada
Fag Bearings Ltd.
Freddy Products Inc.
Fuel Cell Technologies
Global Thermoelectric Inc.
Hermes Electronics Inc.
HVR Canada Inc.
IE Power Inc.
IES Imagery Exploitation Services Inc.
Imago Machine Vision Research Inc.
Indal Technologies
Intercon Consultants

Intergraph Canada Inc.
Intermap Technologies
Irvin Aerospace Canada Ltd.
JML Shirt Ltd.
LES Industries Inc.
LGS Group Inc.
Lincoln Fabrics
Litton Systems Canada Inc.
Lockheed Martin
Lockheed Canada
MIL Systems Inc.
Military International Ltd.
Multidev JDL Communications Inc.
National Coating Technologies Inc.
NCI Navatar Canada Inc.
O'Dell Engineering Ltd.
Orenda Aerospace Corp.
Prior Data Sciences Ltd.
Raber Glove Manufacturing Co. Ltd.
Racal Canada Inc.
Ratheon Canada Ltd.
R Nicholls Distribution
SBC Case Industries Ltd.
Science Applications International Corp.
SED Systems Inc.
Sensor Technology Ltd.
Sikorsky Aircraft Corp.
Teleflex Ltd.
Telemus Inc.
Terra Surveys Ltd.
Thomson-CSF Systems Canada Inc.
Trilith Technologies Inc.
TRW Canada Ltd.
Tulmar Safety Systems Inc.
Union of National Defence Employees
Vac Aero International Inc.
Valcom Ltd.
Valley Associates Inc.

Appendix 5

Data Analysis Method

Data Analysis Method

The data analysis was carried out using survey responses from 75 Canadian Defence Companies. The data from each of the surveys was manually entered in an SPSS file (i.e. data.sav). Once all the data was stored in this file, it was transferred into a SAS usable file in order to run the logistic regressions and SUR analysis. In order to transfer the data out of the SPSS file it had to be saved as a portable file (i.e. data.por). Then it was converted from the dos format to the unix format using the following command:

(sebastian): dos2unix data.por data

Once this was completed the SAS package was used to run:

- a) **The logistic regressions with the R-square output**
- b) **The linear regressions with the SUR analysis**

The complete commands used in the SAS package are included in the following pages.

The output results can be seen in Appendices 6, 7, and 10.

SAS Commands

Seemingly Unrelated Regression

```
libname savex spss '/home/jweather/data';
libname jason v607 '/home/jweather';
proc convert spss=savex out =jason.dat; run;
proc contents; run;
proc print; run;
proc syslin data=jason.dat sur simple;
```

```
consol: model consol = LOGEMPA AGEA PERCENTA CLASSA
PERPRIMA CULTUREA EXPERA2 EXPERTA2;
```

```
divers: model divers = LOGEMPA AGEA PERCENTA CLASSA
PERPRIMA CULTUREA EXPERA3 EXPERTA3;
```

```
downsize: model downsize = LOGEMPA AGEA PERCENTA CLASSA
PERPRIMA CULTUREA EXPERA1 EXPERTA1;
run;
```

Logistic Regression

```
libname savex spss '/home/jweather/data';
libname jason v607 '/home/jweather';
proc convert spss=savex out =jason.dat; run;
proc contents; run;
proc print; run;
proc logistic data=jason.dat;
consol: model consol = LOGEMPA AGEA PERCENTA CLASSA
PERPRIMA CULTUREA EXPERA2 EXPERTA2/ rsquare; run;
proc logistic data=jason.dat;
divers: model divers = LOGEMPA AGEA PERCENTA CLASSA
PERPRIMA CULTUREA EXPERA3 EXPERTA3/ rsquare; run;
proc logistic data=jason.dat;
downsize: model downsize = LOGEMPA AGEA PERCENTA CLASSA
PERPRIMA CULTUREA EXPERA1 EXPERTA1/ rsquare; run;
```

Appendix 6

Data Analysis

Data Analysis

The variables, which were used in the data analysis, are as follows:

Dependent:

CONSOL	Consolidation
DOWNSIZE	Downsizing
DIVERS	Diversification

Independent:

LOGEMPA	The log of the size of the company.
AGEA	The age of the company.
CLASSA	The product class of the company.
PERCENTA	The percentage of defence work done by the firm.
PERPRIMA	The percentage of work done as a prime contractor.
CULTUREA	The type of culture at the company.
EXPERA1	The experience at the firm regarding Downsizing
EXPERA2	The experience at the firm regarding Consolidation
EXPERA3	The experience at the firm regarding Diversification
EXPERTA1	The expertise at the firm regarding Downsizing
EXPERTA2	The expertise at the firm regarding Consolidation
EXPERTA3	The expertise at the firm regarding Diversification

The values for the variables were taken from the respondent's answers to Part 2 (company state before the strategic action). This shows the characteristics of the company at the time they chose to pursue a certain strategy.

The variables that were used were the six factors outlined in the model. The restructuring factor was composed of two different variables: the experience of a company in pursuing a particular strategy, and the expertise in-house for undertaking the particular strategy. The product class variable was derived from the 8-category question regarding the specific areas within which a company operates. From these 8 categories the company was classified in 4 other categories depending on the defence dependency of that company's products/services. This would indicate whether the company has strictly defence products or easily convertible products for the commercial market.

The establishment of the 4 categories and the placement of the companies was dependent on a number of factors. These included: past literature and research, the responses given in the product class question as well as other questions, and company profiles and descriptions obtained from the CDIA handbook and the survey. Essentially, class 1 included the Electronic, Communications, and Software categories. Class 2 was made up of Aerospace, Defence Services, and the Other (which was mainly "consulting") categories. Hardware & Vehicles composed class 3 and Weapons essentially made up class 4. These classes were subjective in nature as detailed company and product descriptions as well as personal discretion were used to place the various companies in the four classes.

Another variable that was included because of its relevance to this study was the percentage of work the company does as a prime contractor. The output obtained from the regressions using these variables is included in the following pages.

Descriptive Statistics

All 3 Strategies

Variable	N	Minimum	Maximum	Mean	Std. Deviation
CONSOL	75	.00	1.00	.5733	.4979
DIVERS	75	.00	1.00	.7467	.4378
DOWNSIZE	75	.00	1.00	.4400	.4997
LOGEMPA	75	.69	9.39	4.4381	1.9570
AGEA	75	1.00	135.00	26.2600	23.2222
CLASSA	75	1.00	4.00	2.0667	.9492
PERCENTA	75	.00	100.00	58.6467	36.6097
PERPRIMA	75	.00	100.00	62.6000	38.2375
CULTUREA	75	1.00	5.00	3.1467	1.5219
EXPERA1	75	1.00	5.00	2.3733	1.2055
EXPERA2	75	1.00	5.00	2.1333	1.1311
EXPERA3	75	1.00	5.00	2.7333	1.2770
EXPERTA1	75	1.00	5.00	2.6400	1.3420
EXPERTA2	75	1.00	5.00	2.3333	1.2006
EXPERTA3	75	1.00	5.00	2.6133	1.3546

Consolidation

Variable	N	Minimum	Maximum	Mean	Std. Deviation
CONSOL	43	1.00	1.00	1.0000	.0000
LOGEMPA	43	.69	9.39	4.9387	2.1337
AGEA	43	1.00	82.00	26.5000	20.2052
CLASSA	43	1.00	4.00	2.3721	1.0006
PERCENTA	43	5.00	100.00	73.4651	30.5211
PERPRIMA	43	.00	100.00	67.9070	36.2076
CULTUREA	43	1.00	5.00	3.7907	1.3725
EXPERA1	43	1.00	5.00	2.4651	1.1619
EXPERA2	43	1.00	5.00	2.3721	1.1132
EXPERA3	43	1.00	5.00	2.8372	1.2522
EXPERTA1	43	1.00	5.00	2.7674	1.2118
EXPERTA2	43	1.00	5.00	2.6512	1.1929
EXPERTA3	43	1.00	5.00	2.5349	1.3156

Diversification

Variable	N	Minimum	Maximum	Mean	Std. Deviation
DIVERS	56	1.00	1.00	1.0000	.0000
LOGEMPA	56	.69	9.39	4.3511	2.0351
AGEA	56	1.00	135.00	25.6875	24.2865
CLASSA	56	1.00	4.00	2.1607	.9682
PERCENTA	56	5.00	100.00	66.1250	32.8108
PERPRIMA	56	.00	100.00	63.9821	36.9769
CULTUREA	56	1.00	5.00	3.2857	1.4859
EXPERA1	56	1.00	5.00	2.3929	1.3028
EXPERA2	56	1.00	5.00	2.0357	1.1113
EXPERA3	56	1.00	5.00	2.5893	1.1875
EXPERTA1	56	1.00	5.00	2.6607	1.4178
EXPERTA2	56	1.00	5.00	2.1964	1.2124
EXPERTA3	56	1.00	5.00	2.4643	1.3344

Downsizing

Variable	N	Minimum	Maximum	Mean	Std. Deviation
DOWNSIZE	33	1.00	1.00	1.0000	.0000
LOGEMPA	33	1.10	9.39	5.4117	1.8137
AGEA	33	2.50	135.00	36.0455	27.5597
CLASSA	33	1.00	4.00	2.3333	.9895
PERCENTA	33	3.50	100.00	69.3485	31.4520
PERPRIMA	33	.00	100.00	64.3333	39.0790
CULTUREA	33	1.00	5.00	3.8485	1.3491
EXPERA1	33	1.00	5.00	2.6667	1.0508
EXPERA2	33	1.00	4.00	2.0909	.9139
EXPERA3	33	1.00	5.00	2.6061	1.1710
EXPERTA1	33	1.00	5.00	2.7879	1.1661
EXPERTA2	33	1.00	5.00	2.2727	1.0975
EXPERTA3	33	1.00	5.00	2.3636	1.2201

Correlation Matrices

Consolidation

	Constant	AGEA	CLASSA	CULTUREA	EXPERA2	EXPERTA2	LOGEMPA
Constant	1.00000	-.02870	-.34861	-.31048	.24751	-.53491	-.50876
AGEA	-.02870	1.00000	.17236	-.26388	.01677	-.06400	-.32007
CLASSA	-.34861	.17236	1.00000	-.13232	-.29093	.31258	-.09907
CULTUREA	-.31048	-.26388	-.13232	1.00000	-.14397	.21395	.00115
EXPERA2	.24751	.01677	-.29093	-.14397	1.00000	-.82963	-.17835
EXPERTA2	-.53491	-.06400	.31258	.21395	-.82963	1.00000	.18300
LOGEMPA	-.50876	-.32007	-.09907	.00115	-.17835	.18300	1.00000
PERPRIMA	-.09207	-.09548	-.14149	.18198	-.08997	.04985	-.15807
PERCENTA	-.05739	.21204	-.25972	-.54691	.18376	-.14313	.23661

	PERPRIMA	PERCENTA
Constant	-.09207	-.05739
AGEA	-.09548	.21204
CLASSA	-.14149	-.25972
CULTUREA	.18198	-.54691
EXPERA2	-.08997	.18376
EXPERTA2	.04985	-.14313
LOGEMPA	-.15807	.23661
PERPRIMA	1.00000	-.35261
PERCENTA	-.35261	1.00000

Diversification

	Constant	AGEA	CLASSA	CULTUREA	LOGEMPA	PERPRIMA	PERCENTA
Constant	1.00000	-.06160	-.30047	-.30188	-.39597	-.12308	.23286
AGEA	-.06160	1.00000	.16243	-.20031	-.35472	-.17477	.20573
CLASSA	-.30047	.16243	1.00000	-.12248	-.20746	-.22606	-.22608
CULTUREA	-.30188	-.20031	-.12248	1.00000	-.06381	.21501	-.78724
LOGEMPA	-.39597	-.35472	-.20746	-.06381	1.00000	-.17294	.10261
PERPRIMA	-.12308	-.17477	-.22606	.21501	-.17294	1.00000	-.24009
PERCENTA	.23286	.20573	-.22608	-.78724	.10261	-.24009	1.00000
EXPERA3	-.04877	.00842	.05120	-.25609	-.15188	.11662	.14409
EXPERTA3	-.35343	.00547	.04184	.28871	.22729	-.10779	-.19434

	EXPERA3	EXPERTA3
Constant	-.04877	-.35343
AGEA	.00842	.00547
CLASSA	.05120	.04184
CULTUREA	-.25609	.28871
LOGEMPA	-.15188	.22729
PERPRIMA	.11662	-.10779
PERCENTA	.14409	-.19434
EXPERA3	1.00000	-.83633
EXPERTA3	-.83633	1.00000

Downsizing

	Constant	AGEA	CLASSA	CULTUREA	LOGEMPA	PERPRIMA	PERCENTA
Constant	1.00000	-.27178	-.08308	-.26858	-.58459	.05096	-.09890
AGEA	-.27178	1.00000	.12474	-.21831	-.17957	-.16777	.34401
CLASSA	-.08308	.12474	1.00000	-.17959	-.20527	-.15387	-.24784
CULTUREA	-.26858	-.21831	-.17959	1.00000	.01503	.25088	-.64115
LOGEMPA	-.58459	-.17957	-.20527	.01503	1.00000	-.27771	.21188
PERPRIMA	.05096	-.16777	-.15387	.25088	-.27771	1.00000	-.38882
PERCENTA	-.09890	.34401	-.24784	-.64115	.21188	-.38882	1.00000
EXPERA1	.12994	-.02058	-.00319	-.00302	-.36975	.09380	-.08948
EXPERTA1	-.49130	.08448	-.09303	.07464	.39355	-.15370	.05353

	EXPERA1	EXPERTA1
Constant	.12994	-.49130
AGEA	-.02058	.08448
CLASSA	-.00319	-.09303
CULTUREA	-.00302	.07464
LOGEMPA	-.36975	.39355
PERPRIMA	.09380	-.15370
PERCENTA	-.08948	.05353
EXPERA1	1.00000	-.66164
EXPERTA1	-.66164	1.00000

Logistic Regression

Response Variable: CONSOL

Number of Observations: 75

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-6.4303	1.6072	16.0066	0.0001	.	.
LOGEMPA	1	0.5210	0.2221	5.5029	0.0190	0.562163	1.684
AGEA	1	-0.0097	0.0167	0.3396	0.5601	-0.124685	0.990
PERCENTA	1	0.0184	0.0133	1.9198	0.1659	0.371865	1.019
CLASSA	1	0.4632	0.4705	0.9690	0.3249	0.242369	1.589
PERPRIMA	1	-0.0034	0.0091	0.1355	0.7128	-0.070951	0.997
CULTUREA	1	0.4172	0.3166	1.7357	0.1877	0.350018	1.518
EXPERA2	1	-0.4250	0.5256	0.6541	0.4187	-0.265048	0.654
EXPERTA2	1	1.1840	0.5531	4.5826	0.0323	0.783737	3.267

Response Variable: DIVERS

Number of Observations: 75

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	2.1389	1.4272	2.2462	0.1339	.	.
LOGEMPA	1	-0.1457	0.1931	0.5698	0.4503	-0.157228	0.864
AGEA	1	0.0113	0.0143	0.6265	0.4286	0.144537	1.011
PERCENTA	1	0.0415	0.0169	6.0367	0.0140	0.837828	1.042
CLASSA	1	0.0829	0.4500	0.0339	0.8539	0.043375	1.086
PERPRIMA	1	-0.0052	0.0089	0.3418	0.5588	-0.109079	0.995
CULTUREA	1	-0.5550	0.3892	2.0333	0.1539	-0.465685	0.574
EXPERA3	1	-0.0301	0.4412	0.0046	0.9457	-0.021165	0.970
EXPERTA3	1	-0.3278	0.4291	0.5835	0.4450	-0.244779	0.721

Response Variable: DOWNSIZE

Number of Observations: 75

Variable	DF	Parameter Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Standardized Estimate	Odds Ratio
INTERCPT	1	-6.0311	1.5419	15.2995	0.0001	.	.
LOGEMPA	1	0.5764	0.2457	5.5030	0.0190	0.621912	1.780
AGEA	1	0.0394	0.0191	4.2562	0.0391	0.505021	1.040
PERCENTA	1	0.0186	0.0149	1.5472	0.2136	0.374692	1.019
CLASSA	1	0.0681	0.4196	0.0263	0.8711	0.035633	1.070
PERPRIMA	1	-0.0129	0.0093	1.9443	0.1632	-0.272943	0.987
CULTUREA	1	0.2997	0.3220	0.8661	0.3520	0.251446	1.349
EXPERA1	1	-0.0920	0.3327	0.0766	0.7820	-0.061181	0.912
EXPERTA1	1	0.3922	0.3113	1.5871	0.2077	0.290169	1.480

Appendix 7

R-Square

R-Square

Response Variable: **CONSOL**

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	104.353	80.693	.
SC	106.670	101.551	.
-2 LOG L	102.353	62.693	39.660 with 8 DF (p=0.0001)
Score	.	.	32.390 with 8 DF (p=0.0001)

RSquare = 0.4107 Max-rescaled RSquare = 0.5516

Response Variable: **DIVERS**

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	86.895	88.102	.
SC	89.213	108.959	.
-2 LOG L	84.895	70.102	14.794 with 8 DF (p=0.0363)
Score	.	.	13.713 with 8 DF (p=0.0684)

RSquare = 0.1790 Max-rescaled RSquare = 0.2642

Response Variable: **DOWNSIZE**

Criterion	Intercept Only	Intercept and Covariates	Chi-Square for Covariates
AIC	104.889	85.964	.
SC	107.207	106.822	.
-2 LOG L	102.889	67.964	34.925 with 8 DF (p=0.0001)
Score	.	.	28.530 with 8 DF (p=0.0004)

RSquare = 0.3723 Max-rescaled RSquare = 0.4988

Appendix 8

Logistic Regression

Logistic Regression

Logistic regressions were used in this study since the dependent variables are dichotomous (having a value of either 0 or 1).

The conditional probability that the outcome is present is denoted by:

$$P(y=1/x) = \pi(x),$$

where 1. y denotes the outcome variable.

2. x denotes a value of the independent variable.

3. $\pi(x)$ is the conditional mean of y given x .

The left-hand side of the logistic equation is:

$$\text{Log} \{ \pi(x) / [1 - \pi(x)] \} = g(x),$$

where $\pi(x)$ represents, in this study, the probability that the particular strategy has a value of one (i.e. Consol = 1).

The logit of the multiple logistic regression model is given by the equation:

$$g(x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p,$$

where β_i represents the estimate coefficients.

The estimated logits for the three strategies are as follows:

Consol: $g(x) = -6.4303 + 0.5210(\text{Logempa}) - 0.0097(\text{Agea}) + 0.0184(\text{Percenta}) + 0.4632(\text{Classa}) - 0.0034(\text{Perprima}) + 0.4172(\text{Culturea}) - 0.4250(\text{Expera2}) + 1.1840(\text{Experta2})$

Divers: $g(x) = 2.1389 - 0.1457(\text{Logempa}) + 0.0113(\text{Agea}) + 0.0415(\text{Percenta}) + 0.0829(\text{Classa}) - 0.0052(\text{Perprima}) - 0.5550(\text{Culturea}) - 0.0301(\text{Expera1}) - 0.3278(\text{Experta1})$

Downsize: $g(x) = -6.0311 + 0.5762(\text{Logempa}) + 0.0394(\text{Agea}) + 0.0186(\text{Percenta}) + 0.0681(\text{Classa}) - 0.0129(\text{Perprima}) + 0.2997(\text{Cultura}) - 0.0920(\text{Expera3}) + 0.3922(\text{Experta3})$

The estimated coefficients for the independent variables represent the slope or rate of change of a function of the dependent variable per unit of change in the independent variable.

For a linear regression model we recall that the slope coefficient, β_1 , is equal to the difference between the value of the dependent variable at $x + 1$ and the value of the dependent variable at x , for any value of x .

In the logistic regression model $\beta_1 = g(x + 1) - g(x)$. That is, the slope coefficient represents the change in the logit for a change of '1' unit in the independent variable x .

It is often the case that examining a change of '1' unit of x is not very informative. As such, a larger/smaller unit change is considered.

The log odds for a change of c units in x is obtained from the logit difference $g(x + c) - g(x) = c\beta$ and the associated odds ratio is obtained by exponentiating this logit difference:

$$\psi(c) = \psi(x + c, x) = \exp(c\beta).$$

In considering, for example, the age variable (Agea) for the Downsizing regression, a log odds ratio of 1.4829 can be calculated for a 10-year change. This value reflects that for an increase of 10 years in the age variable, the probability of selecting Downsizing increases 1.48 times.

(Hosmer and Lemeshow, 1989)

Appendix 9

Description of SUR

Description of Seemingly Unrelated Regression

A Seemingly Unrelated Regression (SUR) analysis is used to determine the extent of the correlations between equations. A logistic regression will consider each equation separately, whereas a SUR will consider all three equations jointly, thereby accounting for any correlation between the error terms.

Different equations can be linked both statistically and structurally. For a SUR analysis the equations are linked statistically, but not structurally, through the jointness of the error term's distribution and through the non-diagonality of the associated variance covariance matrix. For structural linkage the variables in the system are both explanatory and dependent in nature. In this case, none of the equations are both simultaneously explanatory and dependent in nature.

There may be interactions between the individual equations if the random disturbances associated with at least some of the equations are correlated with each other. In such a case, treating the model as a collection of separate systems will be sub-optimal when drawing inferences about the model's parameters. The sharpness of these inferences may be improved by taking into account the jointness inherent in the SUR model, rather than ignoring it.

If there are some common factors influencing each firm, then there is the likelihood that similar factors may be responsible for the random effects, necessitating the inclusion of the error term in the regression equations.

If the error term in the first equation reflects the omission of some unobservable variables, then these same variables, or others which are highly correlated with them, may be an important determinant of the variability of the error term in the other equations.

In the present study the existing correlations have been determined to be minimal, thereby allowing the use of straight logistic regression to draw inferences about the model.

Appendix 10

SUR Analysis Results

Seemingly Unrelated Regression Estimation

Cross Model Covariance

Sigma	CONSOL	DIVERS	DOWNSIZE
CONSOL	0.1579291175	-0.002140132	0.0097298326
DIVERS	-0.002140132	0.1756483805	0.0009552072
DOWNSIZE	0.0097298326	0.0009552072	0.1734871326

Cross Model Correlation

Corr	CONSOL	DIVERS	DOWNSIZE
CONSOL	1	-0.012849536	0.0587814954
DIVERS	-0.012849536	1	0.005471947
DOWNSIZE	0.0587814954	0.005471947	1

Cross Model Inverse Correlation

Inv Corr	CONSOL	DIVERS	DOWNSIZE
CONSOL	1.0036419653	0.0132195501	-0.059067912
DIVERS	0.0132195501	1.0002040655	-0.006250129
DOWNSIZE	-0.059067912	-0.006250129	1.0035063006

Cross Model Inverse Covariance

Inv Sigma	CONSOL	DIVERS	DOWNSIZE
CONSOL	6.3550153456	0.0793713005	-0.356850971
DIVERS	0.0793713005	5.6943540433	0.035804139
DOWNSIZE	-0.356850971	-0.035804139	5.7843269737

System Weighted MSE: 0.99993 with 198 degrees of freedom.

System Weighted R-Square: 0.3416

Seemingly Unrelated Regression Estimation

Model: CONSOL

Dependent variable: CONSOL

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	-0.512766	0.180306	-2.844	0.0059
LOGEMPA	1	0.075986	0.028987	2.621	0.0109
AGEA	1	-0.001582	0.002436	-0.649	0.5183
PERCENTA	1	0.003514	0.002127	1.652	0.1032
CLASSA	1	0.065672	0.066754	0.984	0.3288
PERPRIMA	1	-0.000268	0.001379	-0.195	0.8463
CULTUREA	1	0.054203	0.049972	1.085	0.2820
EXPERA2	1	-0.029756	0.072051	-0.413	0.6810
EXPERTA2	1	0.153553	0.068846	2.230	0.0291

Model: DIVERS

Dependent variable: DIVERS

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	0.810911	0.217860	3.722	0.0004
LOGEMPA	1	-0.023510	0.030878	-0.761	0.4491
AGEA	1	0.002365	0.002567	0.921	0.3603
PERCENTA	1	0.006258	0.002228	2.809	0.0065
CLASSA	1	0.021093	0.068012	0.310	0.7574
PERPRIMA	1	-0.001097	0.001456	-0.754	0.4538
CULTUREA	1	-0.069914	0.053764	-1.300	0.1980
EXPERA3	1	-0.009853	0.074098	-0.133	0.8946
EXPERTA3	1	-0.044767	0.071254	-0.628	0.5320

Seemingly Unrelated Regression Estimation

Model: DOWNSIZE

Dependent variable: DOWNSIZE

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	-0.460174	0.183291	-2.511	0.0145
LOGEMPA	1	0.078237	0.031640	2.473	0.0160
AGEA	1	0.006115	0.002555	2.393	0.0195
PERCENTA	1	0.003041	0.002198	1.384	0.1712
CLASSA	1	0.021306	0.067364	0.316	0.7528
PERPRIMA	1	-0.002110	0.001439	-1.466	0.1473
CULTUREA	1	0.047312	0.052147	0.907	0.3676
EXPERA1	1	0.007438	0.055715	0.133	0.8942
EXPERTA1	1	0.051347	0.049168	1.044	0.3001

IMAGE EVALUATION TEST TARGET (QA-3)

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