DIVERSIFICATION STRATEGIES FOR CONSTRUCTION COMPANIES IN THE U.S.

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DIVERSIFICATION STRATEGIES FOR CONSTRUCTION COMPANIES IN TAIWAN AREA

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Submitted to the Department of Civil and Environmental Engineering
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ABSTRACT

After a period of economic recession, in 1994 the U.S. construction industry will recover in a faster step than in 1993. However, how to select and invest from these various related construction industries is an important issue for managers.

A classification system is built according to Rumelt's (1986) original model. Because of the construction industry's distinct characteristics, new rules are devised. By using the fractions of their annual revenues from industries of different four-digit SIC codes, the sample of U.S. construction firms are classified into the groups of different diversification strategies.

The relationships between construction firms' financial performance/risk and their diversification strategies are explored in this research. The multiple regression model is adopted to build two equations. From the equations the factors that significantly affect a construction firm's performance are found, and some suggestions for the directions of investment are proposed.

Thesis Supervisor: Professor Fred Moavenzadeh
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To My Parents
for their greatest love and support

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

In 1993, the value of new construction put in place was equal to about 7.9 percent of gross domestic product (GDP). This is well below the post-World War II peak of 11.9 percent of GDP attained in 1966, and very close to the cyclical low of 7.7 percent in 1982. Construction's share of GDP is expected to remain constant in 1994.

In 1994, the constant-dollar value of new construction put in place will increase about 2 percent, while repair and remodeling work will grow at a faster pace. The homebuilding sector will continue its modest recovery, but commercial construction will decline again. Public works construction will be about the same level as in 1993. In the international construction and engineering arena, near-term opportunities for U.S. companies could be

limited in the industrial economies due to slow growth there, but virtually unlimited infrastructure needs exist in developing countries.

According to National Trade Data Bank, the inflation-adjusted value of new construction put in place increased about 3 percent in 1993. The 1993 value of about $460 billion was an all-time high in current dollars. The number of housing starts increased by about 4 percent to 1.25 million units in 1993. An additional 265,000 manufactured (mobile) homes were shipped, a 26 percent increase. Public works construction increased slightly, led by strong spending for highways. The decline in private nonresidential construction was largely attributable to high vacancy rates in commercial buildings. Some categories of private nonresidential construction, such as hospitals and electric utilities, were growing markets in 1994.

The following broad economic factors will affect construction demand in 1994: economic growth is expected to be relatively modest;

(1) interest rates are likely to remain near current levels;

(2) real estate finance will continue to be characterized by weak asset prices and lender wariness of commercial property;

(3) plant and equipment expenditures are expected to increase slightly, but investment in buildings will be weaker than investment in equipment;

(4) vacancy rates for apartments and commercial buildings will remain high, depressing prices and the demand for new construction;

(5) government investment is expected to be about the same as in 1993; and

(6) demographic factors are favorable for the construction of schools and hospitals but unpromising for apartments and offices.

During the 1994-98 period, new construction is expected to increase modestly from current levels, but with a slower growth rate than GDP. In addition to market factors, the U.S. construction industry will face a number of supply-side challenges during the next 5 years, including foreign competition, the availability of workers, and the cost of insurance.

Remodeling and repair work increased faster than new construction in 1993 and that year probably was a record year for maintenance and repair work. On the other hand, nonresidential building improvements (commercial remodeling and renovation) declined slightly from the record levels set in 1992.

The construction business has become increasingly international during the past 20 years. Although only a small number of U.S. construction contractors are active internationally, they are among the most successful in the world. In 1992, U.S. contractors won about 49 percent of all international construction contracts, according to the Engineering News-Record. At the same time, many of the world's largest foreign construction contractors entered the U.S. construction market, but they have not made significant inroads here, except in a few specialized sub-markets. Foreign-owned companies accounted for only about 4 percent of all construction contracts awarded in the United States during 1992.

Exports of prefabricated buildings have increased impressively over the past 5 years, with 1993 exports of $285 million. This success is partly due to the cheaper dollar and more commercially oriented foreign aid programs. In addition, U.S. industry has become

aware that there are viable but specialized foreign markets for prefabricated buildings, and firms are stepping up their foreign marketing efforts.

The total value of new construction will increase about 2 percent in constant dollars, while repair and remodeling work will grow at a slightly faster pace. The most promising markets appear to be home improvement, hospitals, telecommunications, highways, and water supply. The weaker construction markets are expected to be office buildings, hotels, public service buildings, military facilities, and Federal industrial plants.

Housing starts will be about 1.3 million units in 1994, about 4 percent more than in 1993. Private nonresidential construction will decline slightly, as weakness in commercial building markets will more than offset strength in hospital and utility construction. Public works construction will be about the same as in 1993, as a modest rise in Federal spending is offset by construction cost increases and by declining state and local construction expenditures.

During the 1994-98 period, new construction is expected to increase modestly from current levels, but with a slower growth rate than GDP. Remodeling and repair construction will increase substantially if interest rates remain moderate, with about the same growth rate as the overall economy.

The modest increase in new construction activities is partly due to the oversupply of commercial buildings, which will be gradually absorbed by attrition and a growing economy. The demand for new housing construction will be limited by demographic factors and by a slower buildup in homeowner equity. The Federal budget deficit will limit

spending for public works, despite the well-publicized need for additional infrastructure investment.

The recovery of the U.S. manufacturing sector is expected to result in strong demand for industrial construction during the rest of this decade. Electric utility construction also will be a large and growing market. Hospital construction will continue to gain but will be influenced by the Federal health care initiative. Remodeling and repair work, both residential and nonresidential, is expected to remain a growth area, as the U.S. stock of structures becomes older and more extensive.

The commercial real estate slump is likely to persist through the middle of the decade. As measured by the value of new construction put in place, the sector will decline in 1994, but the bottom may be reached by 1995. Even so, the recovery is likely to be slow, and commercial construction will not even reach current levels by 1998. The downturn is augmented by the failure of record numbers of financial institutions. High vacancy rates and weak building prices have made new construction unprofitable in most cases, and reluctance to make real estate loans has further limited opportunities.

After a period of economic recession, in the near future there seems filled with opportunities in some of the construction industries, no matter in the domestic or international market, while the rest will be still weak. Therefore, to adjust itself in the industries and face the challenges, a U.S. construction firm has to carefully evaluate and analyze possible risks, choose a better way to invest and change its direction of corporate strategies: to diversify present businesses into more profitable industries, or stay at where it is with, at least, minimizing the loss, in this changeable environment.

1.2 RESEARCH GOALS AND SCOPE

1.2.1 Research Goals

The goals of this research are:

(1) By using Rumelt's (1982) methodology to set up a rule of classifying construction firms into different categories of diversification strategies and examine it with a sample of U.S. construction firms.

(2) Explore the relationships between diversification strategies and financial performance/risk of the sample U.S. construction companies.

(3) Analyze the diversification strategies with which the U.S. construction companies operate their businesses.

(4) Find the evaluation factors with which the U.S. construction companies make investments and suggest a more profitable investment portfolio .

After the case examinations of the basic assumptions, the final results of this research will include:

(1) A classification method with which the U.S. construction firms are to be classified into different categories of diversification strategies.

(2) The results of classification of the sample U.S. construction firms.

(3) The present information of corporate diversification strategies in the U.S. construction industry.

(4) Two multiple regression models with the dependent variables ROA and Risk, respectively; the models are used to examine the factors which would influence the

financial performance of the U.S. construction firms adopting different diversification strategies.

(5) Conclusion and discussion of the multiple regression models, and suggestion of the future direction of research.

1.2.2 Research Scope and Limitation

This research focuses on the U.S. construction industry, and all the data collected are within the period 1989-1992. The sample of U.S. construction firms for classification were randomly chosen, including public companies, private companies, and subsidiaries. However, at the second part of research, the multiple regression analysis, because all variables are from balance sheets, income statements, and other financial reports, there would be possible selection bias if the data are from different sources. Therefore, the author uses Moody's Manual, a reference which stores all the American public firms' financial data, as the uniform source of data to avoid the bias.

1.3 ORGANIZATION OF RESEARCH

The organization of the research can be divided into three parts:

(1) The process of producing the thesis:

Fig 1.1 describes the flow chart of each phases of this research.

(2) The conceptual structure:

The conceptual structure basically follows that of Alfred D. Chandler, Jr. (1966). He proposed the concept of "environment changes→ strategy changes→ organization changes", that is, the chain reaction in which once the external environment changes, the strategy must react to these changes, and the organization also has to be modified to react the change of the strategy. In this research, the author would like to introduce financial performance and risk into this structure in order to explore their effects on the business.

From Fig. 1.2, we can infer that the environment and the characteristics (environmental factors) would affect the direction and the mode (strategic factors) which the firms adopt while in growth. In addition, they can influence the consideration of the scale of economies (structural and organizational factor) when firms develop.

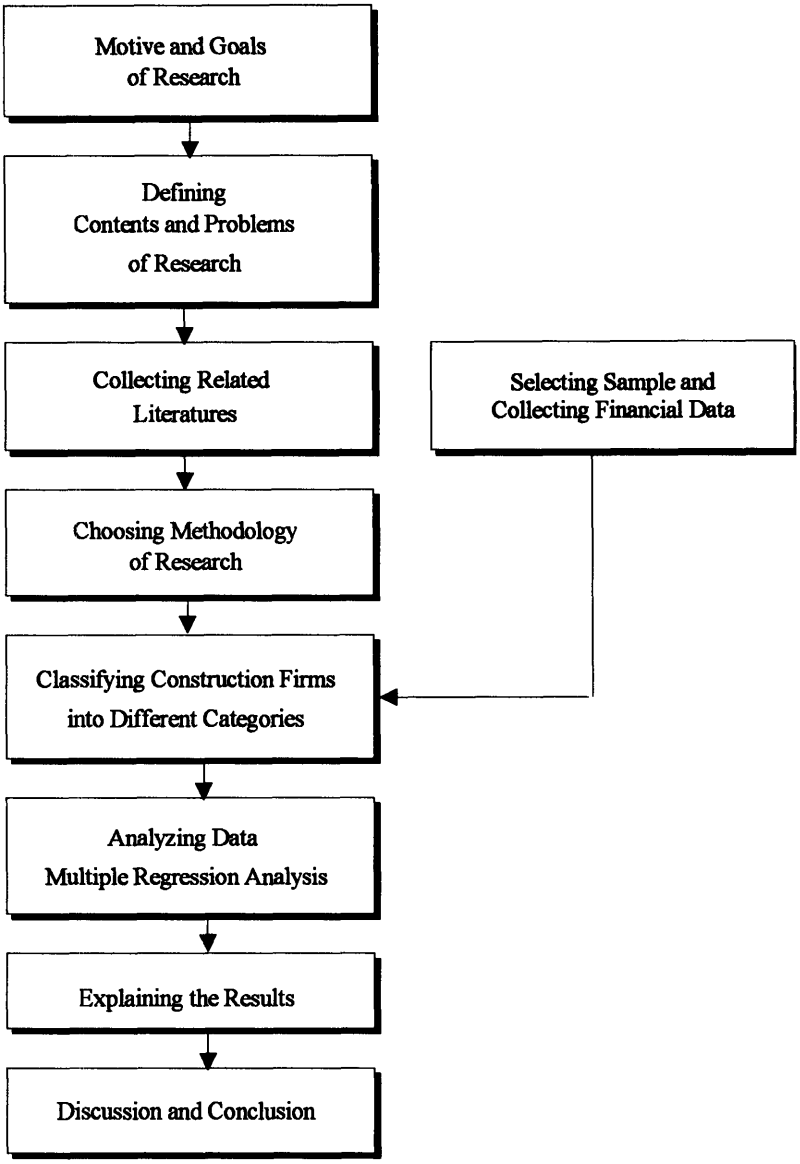


Fig 1.1 The Flow Chart of Research

Besides, these three factors (environmental, strategic, and structural and organizational) would affect the financial performance through the management, the capital structure, and other factors. The strategy that the author

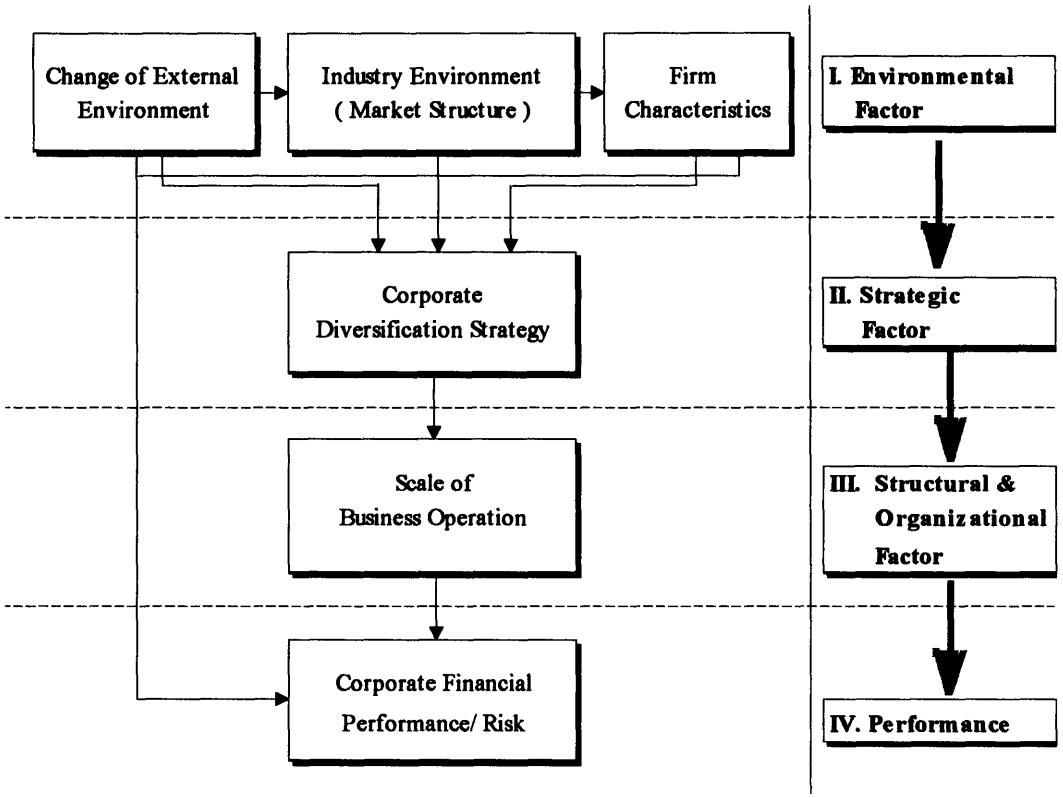


Fig. 1.2 The Conceptual Structure of Research

used in the research is defined as the corporate diversification as defined by Rumelt (1974).

(3) The structure of the thesis:

CHAPTER 1 ~ INTRODUCTION

This chapter describes the research goals and scope, and organization of the research.

CHAPTER 2 ~ BACKGROUND

This chapter includes two parts:

1. Examine the environment of the construction industry in the U.S., and define the existing problems.
2. Review the historical strategic management articles which discuss diversification strategies and describe the results of those studies of corporate diversification.

CHAPTER 3 ~ DIVERSITY STATUS OF THE U.S. CONSTRUCTION FIRMS

This chapter introduces Rumelt's (1982) methodology of the diversification strategy and how it is employed in the research. This chapter also describes a model developed a model to measure the four ratios: SR, VR, RR, and CR, for the classifications of businesses; and describes the procedure of sampling and classifying the construction firms into different categories of diversification strategies.

CHAPTER 4 ~ RESEARCH DESIGN

This chapter describes the analytical tools including ANOVA (analysis of variance), pairwise comparison, and multiple regression analysis. ANOVA and hypotheses are first introduced. Later in this chapter the results of classification from chapter 3 are used together with their various financial data from a 4-year

period 1989-1992. Based on these, two multiple regression models are built. In these models the significant factors which have effects on the ROA and Risk of those firms with different diversification strategies are found.

CHAPTER 5 ~ DISCUSSIONS AND CONCLUSIONS

This chapter discusses the results from the analysis conducted in this research and draws conclusions. The limitations of the research are also described. Some suggestions for the U.S. construction firms and the future direction of research are proposed.

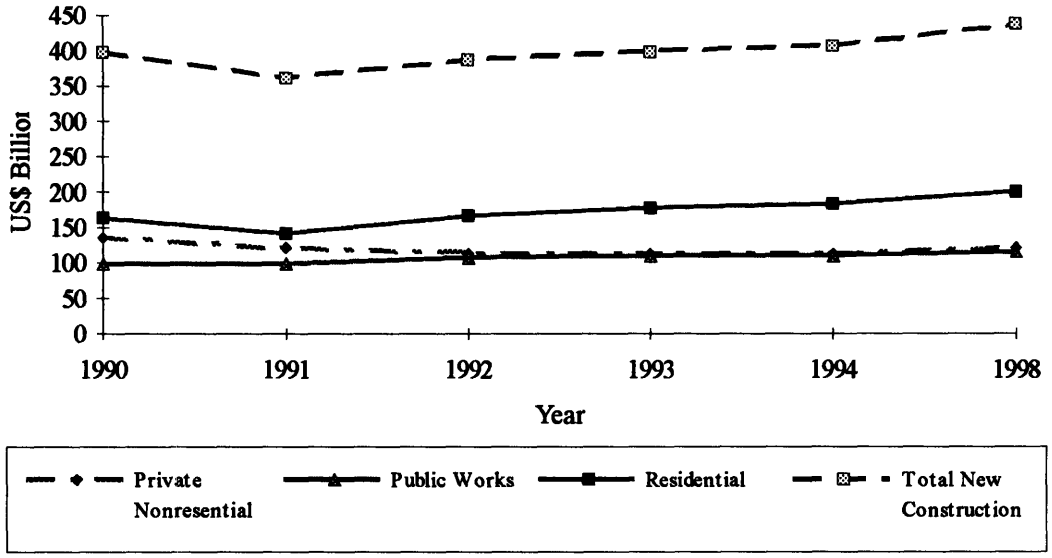
CHAPTER 2

BACKGROUND

2.1 THE ENVIRONMENT OF CONSTRUCTION INDUSTRY IN THE U.S.

In chapter 2.1, the environment of the U.S. construction industry is explored from different related fields: (1) private residential construction (including single-unit, multiunit, and manufactured housing), (2) prefabricated buildings, (3) private nonresidential construction, (4) publicly owned construction, (5) international construction and engineering, and (6) construction materials. The trend of new construction of whole

Fig 2.1 Value of New Construction Put in Place, 1990-98



industry is shown in Figure 2.1; the source of data is U.S. Department of Commerce: Bureau of Census; International Trade Administration (ITA)..

2.1.1 Private Residential Construction

Housing recorded the strongest growth among the construction sectors in 1993. The current-dollar value of new residential construction amounted to $205 billion. After adjusting for inflation, this was a 6.5 percent rise over 1992, and the second year of recovery from the 1991 recession.

New housing starts in 1994 would be the second consecutive annual gain of 4 percent. Total new housing construction should rise 4 percent (in real terms). In long-term

prospects, new residential construction will grow slowly, probably less than the overall economy.

2.1.2 Prefabricated Buildings

Prefabricated buildings are structures that are built using various forms of factory-produced items, which range from simple components (such as roof trusses, wall panels, and pre-hung doors and windows) to three-dimensional, 95 percent-complete modular units. Buildings are manufactured from wood (SIC 2452) or metal (SIC 3448) and can be designed for residential or commercial applications.

The continuing weak domestic market for U.S. building construction during 1992 increased U.S. companies' emphasis on strong export markets to offset declining domestic sales. Total industry shipments (domestic and export) declined in both current and constant dollars in 1992.

2.1.3 Private Nonresidential Construction

In 1993, the value of new private nonresidential construction was about 1 percent less in constant dollars than in 1992. The declines of 1993 were most severe for office buildings and hotels, while the construction of hospitals and electric utility plants registered solid increases.

The weakness in nonresidential construction reflects the aftermath of the phenomenal commercial building boom of the 1980's. The record amounts of new building space,

combined with the slowdown in economic growth, have resulted in record vacancy rates for office buildings, stores, hotels, and warehouses.

New private nonresidential construction will decline by about 1 percent, despite the expected modest growth in GDP and total business investment. All of the net increase in business plant and equipment expenditures will be in capital equipment, rather than in buildings and other structures.

The most construction growth in 1994 is expected to be in hospitals and other health institutions, electric power utilities, and telecommunications. They will continue to do well through the mid-1990's. The largest declines in 1994 will be in commercial construction, especially office buildings and hotels, where capacity surpluses are greatest.

The nonresidential repair and renovation markets probably will continue to grow in 1994. Electric utilities in particular are likely to increase their maintenance and repair expenditures substantially. The rapid growth rates of this type of construction probably will continue over for the next several years.

Growth in total private nonresidential construction is likely to lag increases in the overall economy over the next 5 years, given high vacancy rates for commercial buildings, continued liquidation of failing thrift institutions, and relatively modest growth in GDP. However, the decline will be entirely in commercial construction. Industrial, utility, and hospital construction probably will increase from 1993 to 1998.

Manufacturing Facilities

The real value of industrial construction put in place decreased in 1993, but the decline is expected to end in 1994 as the economy recovers. The long-term rate of increase may be lower than in previous recoveries because of modest corporate profits and slower economic growth. Although the long-term outlook for industrial construction is subject to many uncertainties, it is likely to be one of the stronger construction markets during the next 5 years. The general economic climate should be moderately favorable for industrial construction. However, negative factors include continued uncertainty about the economy, regulatory burdens, and heavy debts of many companies.

Office Buildings

Office construction in 1993 was 35 percent below its 1985 record. Office vacancy rates have remained high, and building prices have fallen. Further declines are expected in 1994 and for several years thereafter because of high vacancy rates, slower growth in white-collar employment, and poor financial conditions in the real estate industry. Nevertheless, a sizable amount of office construction will continue because of strength in a small number of cities and market niches.

Hotels and Other Commercial Buildings

The "other commercial buildings" category consists of all commercial buildings, except office buildings and hotels, and includes warehouses, grain elevators, shopping centers, parking garages, banks, fast-food restaurants, and gasoline stations. According to economic and demographic forecasts for the next 5 years, there will be further increases in the number of vehicle-miles driven and in the demand for auto service and repairs.

Construction of hotels and motels declined sharply in 1993, reflecting the end of an international hotel building boom. A further decline is likely in 1994 to bring capacity more in line with market demand. Fortunately, the underlying demand for hotel lodging is expected to grow steadily in the long term and eventually will stop the decline in hotel construction.

Private Electric Utilities

Electric utility construction increased slightly in 1993, continuing a recovery that should last through the first half of the 1990's. This construction includes new power plants, transmission lines, pollution control facilities, conversion of existing power plants from oil and gas to coal, and modernization of existing power plants and other buildings.

Hospital and Institutional

This category includes hospitals, outpatient clinics, nursing homes, convalescent homes, orphanages, and similar institutions for prolonged care. Construction of health care facilities increased by 5 percent in 1993, and a similar gain is expected in 1994. During 1994-98, this construction probably will be one of the fastest-growing markets.

Construction of nursing homes, which service the most rapidly growing segment of the population, is likely to increase even faster than overall health care construction. Between 1980 and 1990, the nation's nursing home population grew by 24 percent, and demographic projections indicate it may grow even faster between 1990 and 2000.

2.1.4 Publicly Owned Construction

The value of publicly owned construction put in place increased about 3 percent in constant dollars in 1993, primarily because of gains in highways, water works, conservation and development, and Federal industrial facilities.

Public works construction has increased substantially over the last decade, although it is still below (in constant dollars) the record level reached in 1968. The vast U.S. highway network helps U.S. industrial productivity by allowing faster and cheaper transportation of products. Other types of infrastructure, such as airports, schools, waterworks, prisons, and mass transit also contribute to productivity.

Public works construction will increase modestly during the 1994-98 period, assuming moderate economic growth and fairly stable interest rates. As in the private sector, maintenance and repair spending probably will increase faster than new public construction spending because the public works infrastructure is steadily becoming older and larger.

Transportation Infrastructure

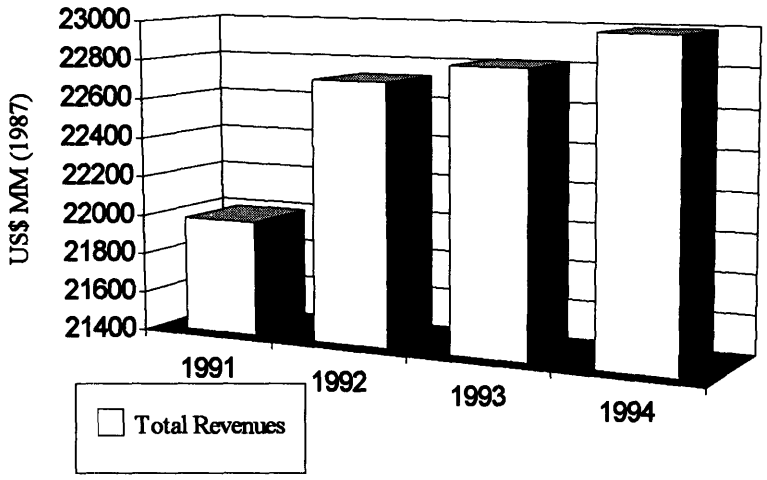
New road and bridge construction increased 5 percent in 1993, and probably will be up again in 1994. Expenditures for highway maintenance and repair also have risen, partly at the expense of new construction. This trend is likely to continue through the mid-1990's.

In the longer term, highway construction expenditures probably will increase further to prevent a decline in the condition of the nation's highway infrastructure.

Water and Sewer Systems

Water and sewer construction increased in 1993, and should increase again in 1994. Demand for water and sewer construction is being sustained by the recovery in homebuilding, which requires expansion of feeder/connector systems and treatment plants. Sewerage construction is likely to continue to gain after 1994, although at a slower rate

Fig 2.2 Annual Revenues of Construction Materials, 1991-94



than the overall economy. The relatively modest but sustained recovery in homebuilding also will support sewerage construction.

In the longer term, waterworks probably will be one of the more rapidly growing categories of public construction because of ancient aqueduct systems in most older cities.

Educational Buildings

New construction expenditures for schools, libraries, and museums decreased slightly in 1993.

2.1.5 International Engineering and Construction

In 1992, U.S. engineers and constructors positioned themselves for and profited from significant new opportunities in world markets. According to the Engineering News-Record (ENR), U.S. companies have dramatically increased their business and maintained their preeminent position in the global international engineering and construction market. Forty percent of the 200 top international design firms were from the United States. U.S. companies obtained 51 percent of total international billings of $12 billion in 1992. Designers increased their foreign billings by about 43 percent over 1991, to $6.6 billion.

U.S. firms will have to reassess carefully their marketing strategies in 1994. The global environment will continue to present unusual opportunities for U.S companies. During at least two decades of domestic environment cleanup activity, U.S. firms have acquired a unique expertise in lessening or preventing air, water, and soil pollution. In the foreseeable future, U.S. engineers, contractors, and equipment suppliers will find lucrative environmental management markets overseas.

The cleanup of the world's environment will be one of the more significant global issues of the 1990's. Environmental projects will provide significant overseas opportunities for U.S. firms. Some environmental problems can be solved on a global basis and in partnership with governments and companies in both developed and developing countries.

2.1.6 Construction Materials

Shipments for eight of the nine industries related to construction materials should grow modestly in 1994. All increases will be in the 1-to-4 percent range. Demand for

construction materials rose modestly in 1993, reflecting the 3 percent rise in constant-dollar construction put-in-place. This was the second consecutive small increase in construction work since the 1990-91 recession. The trends and forecast of construction materials is shown in Fig 2.2; the source of data is U.S. Department of Commerce: Bureau of Census; International Trade Administration (ITA).

The long-term increase in the size and features of new single-family houses have tended to increase demand for construction materials. Construction work on existing structures continues to be an excellent market for construction materials.

Demand for construction materials should increase modestly for the third straight year. In 1994, the United States should continue to show a modest trade surplus in construction materials, although the surplus is likely to be less than the $45 million expected in 1993. Both exports and imports should increase, but imports may rise at a faster pace. Longer-term demand for construction materials will continue to reflect the pace of the economic recovery.

Fabricated Structural Metal

The output of the fabricated structural metal industry continues to decline, with shipments in 1992-93 below the 1989 level. As a result of favorable foreign exchange rates, U.S. exports of fabricated structural metal have been at a high level in the last several years. Reflecting these substantial declines in almost all of the major markets, shipments of fabricated structural metal will drop by about 2 percent. However, by 1996 and 1997, all of these markets may improve. If so, shipments of fabricated structural metal

will increase again. Exports of fabricated structural metal will continue at historically high levels.

Cement

Demand for hydraulic cement (SIC 3241) rose modestly in 1993, following a stronger increase in 1992. Cement consumption in 1994 will increase about 2 percent.

Based on construction forecasts, the recovery in cement demand will likely be slow. Domestic consumption should rise at a 3 percent rate annually through 1999.

Flat Glass

The flat glass industry is made up of companies that make "float glass" (unfabricated flat glass), and various products made from it, including window glass, cathedral glass, picture glass, laminated glass, motor vehicle windshields and windows, skylight glass, and tempered glass. Overall, the industry (including fabricators of float glass) has not displayed dynamic growth, but float glass production continues to increase.

Ceramic Tile

Following declines during the 1990-91 recession, the ceramic wall and floor tile industry (SIC 3253) experienced an upsurge in shipments in 1992 and 1993. In 1994, ceramic tile consumption should rise 3 to 4 percent, to 1.2 billion square feet.

Plumbing Products

Industry shipments of plumbing fixtures and fittings rose almost 4 percent in 1993, to nearly $5.5 billion. Plumbing fixtures are classified into three industries according to the materials from which they are made: vitreous (SIC 3261), metal (SIC 3431), and plastic (SIC 3088). Metal fittings used with fixtures, such as faucets, shower heads, and drains,

constitute SIC 3432. Total exports continued to grow in 1993. Higher domestic demand will also increase imports again in 1994.

2.2 CORPORATE DIVERSIFICATION STRATEGIES

Studies of diversification have long been a branch of strategic management (SM) research. Along with those concepts as synergy, distinctive competence, and generic strategies, the notions of diversification and diversity occupy a central place in the language and literature of the SM field.

Since Rumelt's (1974) study, a number of articles have been made to replicate, refine, and explain his diversification framework and findings. However, the study by Bettis and Hall (1982) is the first one that explored successfully the linkage between risk and return performance and diversification strategy.

As a topic of research, diversification has a rich tradition. In 1957, Ansoff first discussed diversification strategies in his research article 'Strategies for Diversification.' Then, five years later, in 1962, Chandler and Gort suggested seminal works in this research area. The topic has been examined by business historians, economists, and researchers in the areas of finance, law, and marketing.

In his 'Diversification and Integration in American Industry,' Gort (1962) defined diversification with the concept of "heterogeneity of output" based on the number of markets served by that output. To Berry (1975) diversification represents an increase in the number of industries in which firms are active. Pitts and Hopkins (1982) use the word

"business" rather than "industry," defining diversification as the extent to which firms operate in different business simultaneously. Ansoff's (1957, 1965) notion of

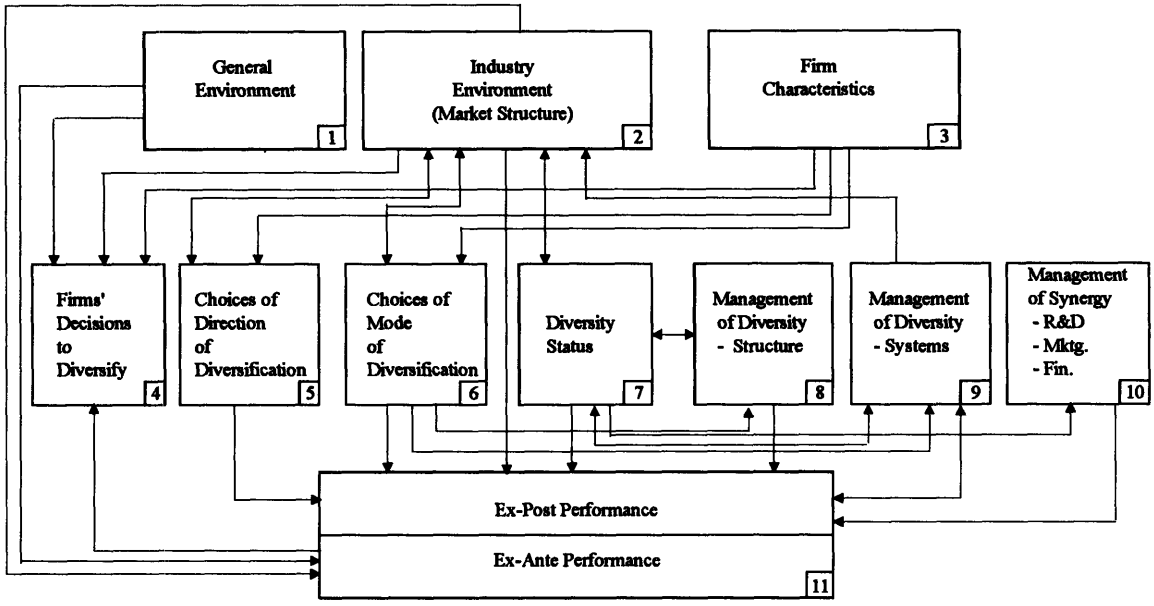


Figure 2.3 Research on Diversification: Themes and Linkages

diversification emphasizes the entry of firms into new markets with new products. According to Ramanujan and Varadarajan (1989), diversification is defined as the entry of

a firm or business unit new lines of activity, either by processes of internal business development or acquisition. From this perspective, simple product line extensions that are not accompanied by changes in administrative linkage mechanisms do not fall under the idea of diversification.

Ramanujan and Varadarajan (1989) proposed a schematic framework of classifying the literatures on diversification in Figure 2.3. Figure 2.3 consists of 11 boxes that represent central themes or concepts in the literature of diversification. Box 1 through Box 3 and

Box 11 represent "generic" strategic management concepts. The concepts include the general environment, the industry environment, firm characteristics, and corporate performance. In contrast, boxes 4 through 10 in the middle level of the framework include themes specific to the topic of diversification.

2.2.1 Direction of Diversification

After firms have found the needs to diversify their business, they then have to make decisions. From his exploration of tobacco industry, Mile (1982) proposed the concept of how firms' diversification decisions were formed by the structure of the industry, the general environment, firm's characteristics, and firm's performance.

Once the decisions were taken, the next issue that firms would face is the direction in which to diversify. According to Abell (1980), a business can be defined with the customer functions it seeks to satisfy, the customer groups it targets, and the technologies it uses in satisfying the customer functions sought by the targeted customer groups. The new lines of activities into which a firm chooses to diversify may therefore involve modifications along one or more of these key dimensions of business definition. Typically, firms concentrate on the dimension that represents their greatest strength or offers the greatest opportunity. Harris and Carleton (1984) find that, firms usually tend to diversify into industries that are similar to their primary industry with advertising intensity, R&D intensity, and/or buyer/seller relationship.

Generally, there are two directions adopted by firms: related diversification and unrelated diversification. Diversification focused on realizing technological and marketing

synergy's can be classified as related diversification, while that undertaken to achieve vertical economies (i.e., reducing costs by integrating backward or forward) or economies in the securing and allocation of financial resources (i.e. the exploration of capital market imperfection) is described as unrelated diversification. According to their works on industrial organization economies, Melicher and Rush (1973) proposed that, conglomerate diversification is usually understood as unrelated diversification.

2.2.2 Mode of Diversification

Besides the directions to diversify, the firms also have to choose the diversification mode. From Ramanujan and Varadarajan's (1989) work, the diversification mode can be describe as "the extent to which the firm relies on internal business development or acquisitions as a mean of entering new lines of activity." The polar extremes are "internal growth," versus "acquisition-based growth."

The rising cost of internal development together with the shortening of product life cycles has rendered acquisition-based diversification increasingly attractive to firms. A number of studies, therefore, focus on acquisitions and mergers as a strategy of growth.

In addition, evaluations of the impact of merger activity as well as the performance of specific mergers appear with increasing frequency in the business press. Executives who built large conglomerates using strategies of acquisition-based growth have also recently contributed their insights on the rationale and effectiveness of unrelated diversification through acquisitions. Other modes of entry into new lines of activity such as licensing, joint ventures and strategic alliances, and providing venture capital support to ostensibly

independent entities, fall somewhere between the pure polar extremes and have been discussed in a number of studies.

2.2.3 Diversity Status

After a firm has engaged in diversification over time and has pursued several diversification projects, by whichever mode it chooses to grow, it attains a certain diversity status or profile. The most prominent of all these studies is the work of Rumelt (1974), which established differences in financial performances across diversification categories and has been extended and replicated in numerous ways. In his scheme it becomes vertically integrated, related-diversified, or unrelated-diversified, each of these has its own finer categories.

Most early industrial organization economics studies have been concerned with the effects of diversification on market structure rather than performance. The diversified firm was, and still is, widely believed to be able to exercise market power through such mechanisms as cross-subsidization, predatory pricing, reciprocity in buying and selling, and creating or raising barriers to entry.

However, the converse idea that market structure determines diversity suggests that different diversity profiles arise due to different forms of market failure. In an influential dissertation, Montgomery (1979) proposed that performance differences attributed by Rumelt (1974) to diversification categories may be due to systematic market structure differences across the diversification categories. The studies of Bettis and Mahajan (1985), Lecraw (1984) and Montgomery (1985) also support this concept. For these reasons,

market structure must be considered a central variable in the literature on diversification and performance. Although market structure has been most often examined as a mediator of the relationship between diversity and performance, it rarely has also been posited to influence other aspects of diversification, e.g., choice of diversification mode.

2.2.4 The Connection of Diversification and Performance

Beattie (1980) provides an overview of various theories of conglomerate diversification:

(1) there are different various of profit-maximizing behavior: the pursuit of monopoly power, the exploitation of cost opportunities due to synergy, and the reduction of risk;

(2) some theories of diversification posit managerial growth-maximizing behavior as the wellspring of diversification decisions; and

(3) financial models assume "financial gamesmanship" on the part of corporate managers as a result of capital market imperfections.

These models concentrate on the accounting effects of diversification activities to verify the efficiency of financial markets rather than to assess the effectiveness of diversification pursued as a growth strategy. In fact, their central proposition is that, under perfect capital markets, diversification should provide no benefits to investors since they can diversify their portfolios themselves at a lesser cost.

2.2.5 Measure of Performance and Implementation of Diversification Strategies

In recent years, there are two main research themes are evident. The first explores the association between risk and return, and also examines the relationship to manager's risk attitude. The second studies the linkage between strategy and risk/return performance.

Building on the work of Chandler (1962) and Wrigley (1970), Rumelt developed four major and nine minor categories to characterize the diversification strategy of large firms. The major categories were:

(1) Single Business.

(2) Dominant Business.

(3) Related Business

(4) Unrelated Business.

The categories provided a spectrum of diversification strategies from firms that remain essentially undiversified to firms that diversified significantly into unrelated area. Rumelt demonstrated a statistical linkage between diversification strategy and financial performance. He found that in his sample of 246 firms:

(1) The related diversification strategies (related-constrained and related-linked) outperformed the other diversification strategies on average.

(2) The related-constrained diversification strategy achieved the highest performance on the average (in related-constrained firms all component business are related to each other, whereas in related-linked firms only one-to-one relationships are required.)

(3) The unrelated diversification strategy produced one of the lowest performance.

In addition, Rumelt found that related diversified firms have an inherent advantage because they are able to extend their "core skills" (e.g., scientific research) into related area.

After Rumelt's study, a number of research efforts have been made to replicate, refine and explain his diversification framework and findings. The study by Bettis and Hall (1982) is the first study that succeeded in the research on the linkage between risk/return performance and diversification strategy. They used return on assets and its standard deviation as a measure of risk/return performance, and found the evidence of a positive risk/return relationship in unrelated firms, a negative relationship in related-linked firms and no relationship in related-constrained firms. Their results suggested that for related-linked firms, it is possible to simultaneously reduce risks and increase returns.

The other prominent study of Bowman (1980) found the risk/return paradox for strategic management at industry level. Using 85 industries and return on equity and its variance, he found the evidence of a negative risk/return relationship in more than 60 percent of industries. He argued that a well-devised strategy could simultaneously reduce risks and increase returns.

CHAPTER 3

DIVERSITY STATUS OF CONSTRUCTION FIRMS IN THE U.S.

3.1 SAMPLE SELECTION

3.1.1 The Scope of SIC Codes

In this research the SIC code system is used for the sample selection. The 1972 Standard Industrial Classification (SIC) Manual has been developed by experts on classification in government and private industry, and is in general use among government agencies and among organizations outside the government. The SIC manual defined construction in three broad types of activity: (1) building construction by general contractors, (2) other construction by general contractors, and (3) construction by special trade contractors.

(1) Building construction by general contractors - General building contractors are primarily engaged in the construction of dwellings, office buildings, stores, farm buildings, and other projects of a similar character.

(2) Other construction by general contractors - Other referred to as heavy construction contractors, these contractors are primarily engaged in the construction of highways, streets bridges, and tunnels; docks and piers; dams and water projects; sewage collection, treatment, and disposal facilities; storm sewer systems; air fields; and other heavy construction which involve either earth moving or the erection of structure and appurtenances, other than buildings.

(3) Construction by special trade contractors - Special trade contractors are primarily engaged in specialized construction activities such as plumbing, painting, electrical work, carpentry, etc.

Table 3.1 shows the industries of two-digit SIC codes 15, 16, and 17, and number of U.S. construction firms of different SIC codes in 1993.

3.1.2 Procedure of Sampling

The sample with which the research uses was selected from the U.S. construction firms. To qualify as a member in the sample, a construction firm must (1) be based in the United States; (2) provide public reports on their financial status; (3) operate its businesses mainly in the fields related to construction industry. In this research, only those firms with main two-digit SIC (standard industrial classification) codes of 15, 16, or 17 (defined by 1982 Census of Construction Industries) are regarded as construction companies.

The sources which the author referred for sampling include:

(1) Million Dollar Director: American's Leading Public and Private Companies. Series 1993.

(2) America's Corporate Families, 1994.

(3) Ward's Business Directory of U.S. Private and Public Companies, 1994.

(4) Standard & Poor's Register of Corporations Directors and Executives, 1994.

(5) Moody's Manual (Industrial, Municipal and Government, OTC Unlisted, Public Utility, Bank and Finance, and OTC), 1994.

The procedure of selecting sample is as follows:

Step 1: Choose public construction firms or those had annual sales of 1993 exceeding 100 million current dollars. There are 391 firms in total.

Step 2: Put numbers on each company, then select 100 from 391 by referring the first three numbers of random values in the random digits table.

To avoid the problems of unavailable financial data, the research chose mainly public construction firms to set the sample.

Table 3.1 SIC Codes of Construction Industries and Number of Firms, 1993

SIC Code	Industry	No. of Firms	Total Firms
15	**BUILDING CONSTRUCTION - GENERAL CONTRACTOR AND OPERATIVE BUILDERS**		
152	General Buildng Constractors - Residential Buildings		
1521	Single-Family Housing Construction	398	
1522	General Contractors - Residential Buildings, Other Than Single-Family	135	
153	Operative Builders		
1531	Operative Builders	54	
154	General Building Contractors - Nonresidential Buildings		
1541	General Contractors - Industrial Buildings and Warehouses	619	
1542	General Contractors -Nonresential Buildings, Other Than Industrial Buildings and Warehouses	800	
			2006
16	**CONSTRUCTION OTHER THAN BUILDING CONSTRUCTION - GENERAL CONTRACTORS**		
161	Highway and Street Construction, Except Elevated Highways		
1611	Highway and Street Construction, Except Elevated Highways	499	
162	Heavy Construction, Except Highway and Street Construction		
1622	Bridge, Tunnel, and Elevated Highway Construction	91	
1623	Water, Sewer, Pipe Line, Communication and Power Line Construction	170	
1629	Heavy Construction, Not Elsewhere Classified	247	
			1007
17	**CONSTRUCTION - SPECIAL TRADE CONTRACTORS**		
171	Plumbing, Heating (Except Eletric), and Air Conditioning		
1711	Plumbing, Heating (Except Eletric), and Air Conditioning	628	
172	Painting, Papre Hanging, and Decorating		
1721	Painting, Papre Hanging, and Decorating	56	
173	Electrical Works		
1731	Electrical Works	426	
174	Masonry, Stonework, Tile Setting, and Plastering		
1741	Masonry, Stonework Setting, and Other Stonework	35	
1742	Plastering, Drywall, Acoustical and Insulation Work	79	
1743	Terrazzo, Tile, Marble, and Mosaic Work	13	
175	Carpentering and Flooring		
1751	Carpentering	24	
1752	Floor Laying and Other Floorwork, Not Elsewhere Classified	17	
176	Roofing and Sheet Metal Work		
1761	Roofing and Sheet Metal Work	118	
177	Concrete Work		
1771	Concrete Work	58	
178	Water Well Drilling		
1781	Water Well Drilling	19	
179	Miscellaneous Special Trade Contractors		
1791	Structure Steel Erection	57	
1793	Glass and Glazing Work	22	
1794	Excavating and Foundation Work	90	
1795	Wrecking and Demolition Work	24	
1796	Installation or Erection of Building Equipment, Not Elsewhere Classified	38	
1799	Special Trade Contractors, Not Elsewhere Classified	193	
			1897
		TOTAL=	4910

Source: Ward's Business Directory of U.S. Private & Public Companies, 1994.

3.2 METHODOLOGY - CLASSIFICATION SYSTEMS

3.2.1 Traditional Classification Approaches

The traditional approach to measuring an enterprise's product-market diversity relies heavily on the SIC definitions of "product class" (typically using 4-digit "industry" codes). Given the number N of such classes in which a firm is active and the fraction p_j of the firm's activity attributable to class *j*, a wide variety of diversification indices may be created. Gort's (1962) composite index, for example, was defined as $D_3 = N / \max(p_j)$ and Berry's (1975) Herfindahl measure was $H = 1 - \sum_j p_j^2$.

Such measure have the advantage of replicability, but all who have used them have noted their shortcomings. Most serious are the varying degrees of breadth in the SIC classes and the implicit assumption of equal 'dissimilarity' between distinct SIC classes.

Instead of a single index of diversity, Wrigley (1970) introduced a new system of classification. Taking the term *specialization ratio* (*SR*) to characterize the proportion of a firm's annual revenues attributable to its largest discrete product-market activity, Wrigley's original categories may be described as follows:

(1) Single Product: firms with *SR* between 0.95 and 1.0.

(2) Dominant Product: firms with *SR* between 0.7 and 0.95.

(3) Related Product: firms with *SR* less than 0.7.

(4) Unrelated Product: firms that diversified (usually by acquisition) into areas that are not related to the original skills and strengths, other than financial, of the firm.

However, this system had some disadvantage:

(1) The terms "single product" and "dominant product" tended to be interpreted too narrowly.

(2) For the classifications to be replicable by other researchers more precise definitions were needed.

(3) Adding some subcategories would be useful to describe certain observable and persistent differences in kind among the firms that fall in several of the categories.

(4) Vertically integrated firms posed special problems.

3.2.2 Rumelt's Classification System

To improve the original functions, Rumelt (1974) built a modified system which is now still popular with researchers. In his study, Rumelt defined the concept of 'diversification strategy', a combination of a strategy and the relationship between competence and opportunity, as (1) the firm's commitment to diversity per se; together with (2) the strengths, skills or purposes that span this diversity, demonstrated by the way new activities are related to old activities.

In 1986, he renewed the version of the older system as follows:

(1) *Specialization Ratio* (SR): the proportion of a firm's annual revenues attributable to its largest single business in a given year.

(2) *Related Ratio* (RR): the proportion of a firm's annual revenues attributable to its largest group of related business. This is defined as a group of businesses such that each is related to at least one other in the group but which need not exhibit any single common skill or resource.

(3) *Related-Core ratio* (CR): the proportion of a firm's annual revenues attributable to its largest group of business which share or draw on the *same* common core skill, strength, or resource.

(4) *Vertical Ratio* (VR): the proportion of a firm's annual revenues attributable to its largest group of products, joint-products, by-products and end products associated with the processing of a raw material through a set of stages.

According to the definitions, *SR* represents the indicator of diversity status used in economics, *RR* and *CR* characterize the horizontal status of diversification strategies, and *VR* is for the vertical status.

By using the four ratios, Rumelt set up a system which included four major categories and all but the Single Business category was divided into subcategories, giving a total of nine different classifications. Fig 3.1 presents a flow diagram that describes the process of categorizing a firm, and Table 3.2 provides the major and minor categories of diversification strategies. Their definitions are arranged in Appendix I.

The dividing line between Related and Unrelated firms was taken to be a related ratio of 0.7. Setting the critical RR equal to the critical SR insures that a firm cannot qualify for the Dominant category on the basis of its SR and for the Unrelated category on the basis of its RR at the same time.

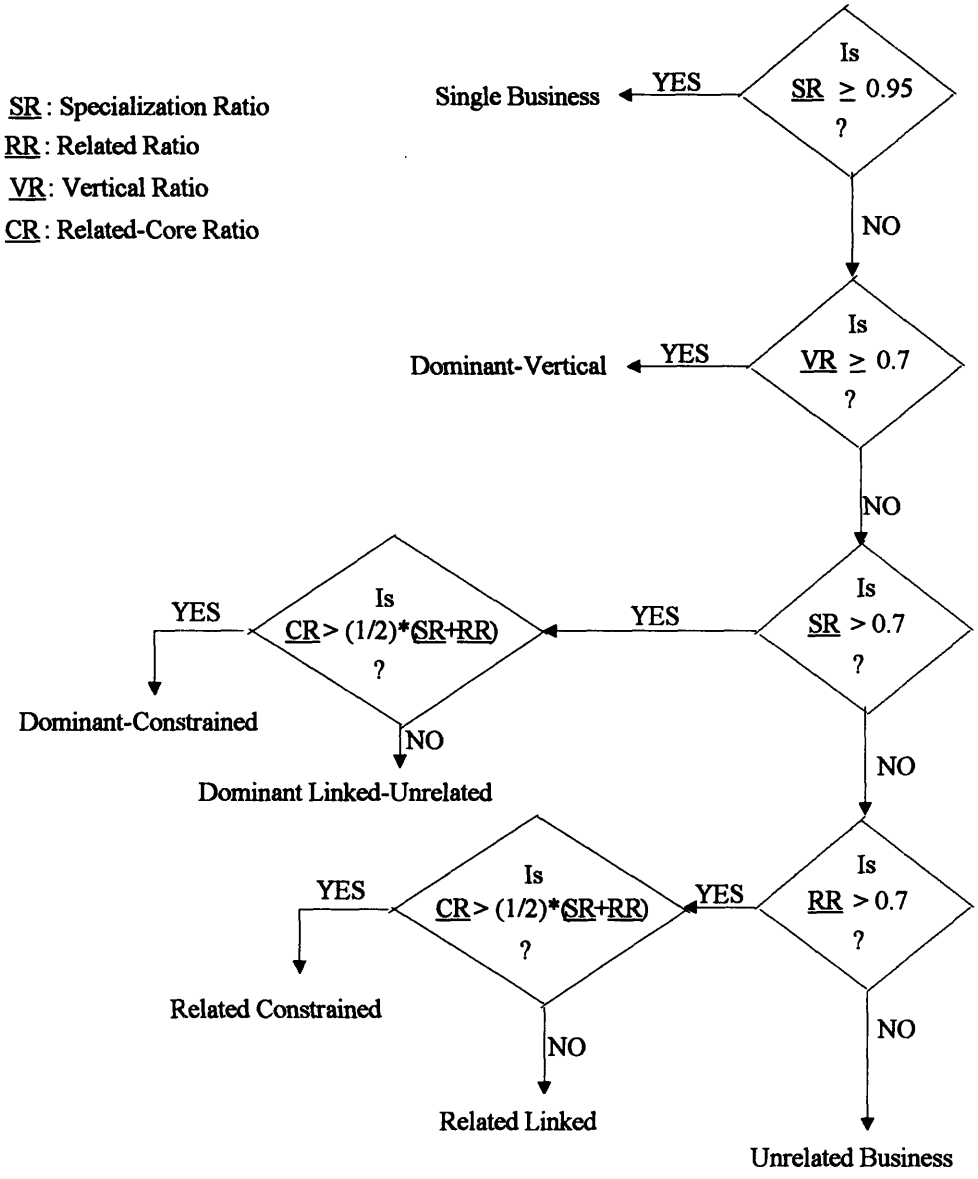


Figure 3.1 Assigning Diversification Categories

Table 3.2 The Categories of Diversification Strategies of Rumelt's System

Number	Major Categories	Minor Categories
1	Single Business	
		(1) Dominant-Vertical
2	Dominant Business	(2) Dominant-Constrained
		(3) Dominant-Linked
		(4) Dominant-Unrelated
3	Related Business	(1) Related-Constrained
		(2) Related-Linked
4	Unrelated Business	(1) Acquisitive Conglomerate
		(2) Unrelated-Passive

3.3 THE CLASSIFICATION OF SAMPLE FIRMS

Before calculating the four ratios needed in the classification of diversification strategy, it is necessary to explain the rules used in this research to define the ranges and relationships between these ratios and construction industries. Because of the distinct characteristics of construction industries, new methods for the production of the four ratios are introduced.

(1) *Specialization Ratio* (SR): according to Rumelt's (1986), it's the proportion of a firm's annual revenues attributable to its largest single business in a given year.

Here the single business is defined as the business of a four-digit SIC code industry.

(2) *Related Ratio* (RR): the fraction of a firm's revenues attributable to its largest group of related business. In this research, the related businesses are defined as the industries, besides those whose two-digit SIC codes of 15, 16, and 17, related to any phase in a construction project. These related businesses include from subdividers and developers, construction sand and gravel, concrete products, construction machinery, engineering and architectural management services, and construction materials.

(3) *Related-Core ratio* (CR): the fraction of a firm's annual revenues attributable to its largest group of business which share or draw on the *same* common core skill, strength, or resource. In this research, this ratio is set equal to RR, because in construction firms the resources and skills are almost shared by its related businesses.

(4) *Vertical Ratio* (VR): the fraction of a firm's annual revenues attributable to its largest group of products, joint-products, by-products and end products associated with the processing of a raw material through a set of stages. In this research, VR is computed according to the nature of the construction firms, such as general building contractors, special trade constructors, or heavy construction firms. For example, a building contractor need to have (a) subdividers and developers that can manage the land; (b) its own subcontractors; (c) engineering and architectural

consultants; sometimes the suppliers of construction materials and architects are also included.

The data of Centex Corp., 1993, shown in Table 3.3, are used as an example to describe how the four ratios are obtained. According to Table 3.3, the largest fraction of Centex Corp.'s revenues in 1993 is 34.026 percent from the industry "General Contractors-Nonresidential Construction, Not Elsewhere Classified", with the SIC code 1542. Therefore, Centex Corp.'s SR is 0.34026. About RR, CR, and VR, the product flow in Fig 3.2 can give a basic idea of how to get these ratios. Those industries at the left side of the vertical dot line are related industry. Therefore, RR and CR are both equal 0.9966. On the other hand, there are two main vertical processes of production, from materials to engineering services. This means Centex Corp. operated its businesses in two vertical streams, the building contractors and heavy construction. The fractions of each industry are 0.40312 and 0.58339, respectively. Since the larger fraction of these two stream is selected for computing VR, here VR is equal to 0.58339.

Table 3.3 Distribution of Revenues, Centex Corp, 1993

SIC Code	Industry	Percentage of Total Revenues
1442	Construction Sand and Gravel	0.155
1521	Single-Family Housing Construction	5.667
1522	Residential Construction, NEC	16.542
1531	Operative Builders	5.944
1541	General Contractors - Industrial Buildings and Warehouses	15.481
1542	General Contractors -Nonresential Construction, NEC	34.026
1629	Heavy Construction, Not Elsewhere Classified	0.369
1771	Concrete Work	0.004
3241	Cement, Hydraulic	1.892
3273	Ready-Mixed Concrete	6.771
3275	Gypsum Products	0.937
5031	Lumber, Plywood, and Mill Work	0.380
5032	Brick, Stone, & Related Materials	0.131
5699	Misc. Apparel & Accesory Stores	0.017
5812	Eating Places	0.017
6162	Mortgage Bankers and Correspondents	11.604
6515	Mobile Home Site Operators	0.017
6541	Title Abstract Offices	0.003
6552	Subdividers and Developers, NEC	0.017
7353	Heavy Construction Equipment Rental	0.014
8721	Accounting, Auditing, & Bookkeeping	0.010

Source: America's Corporate Families, 1994

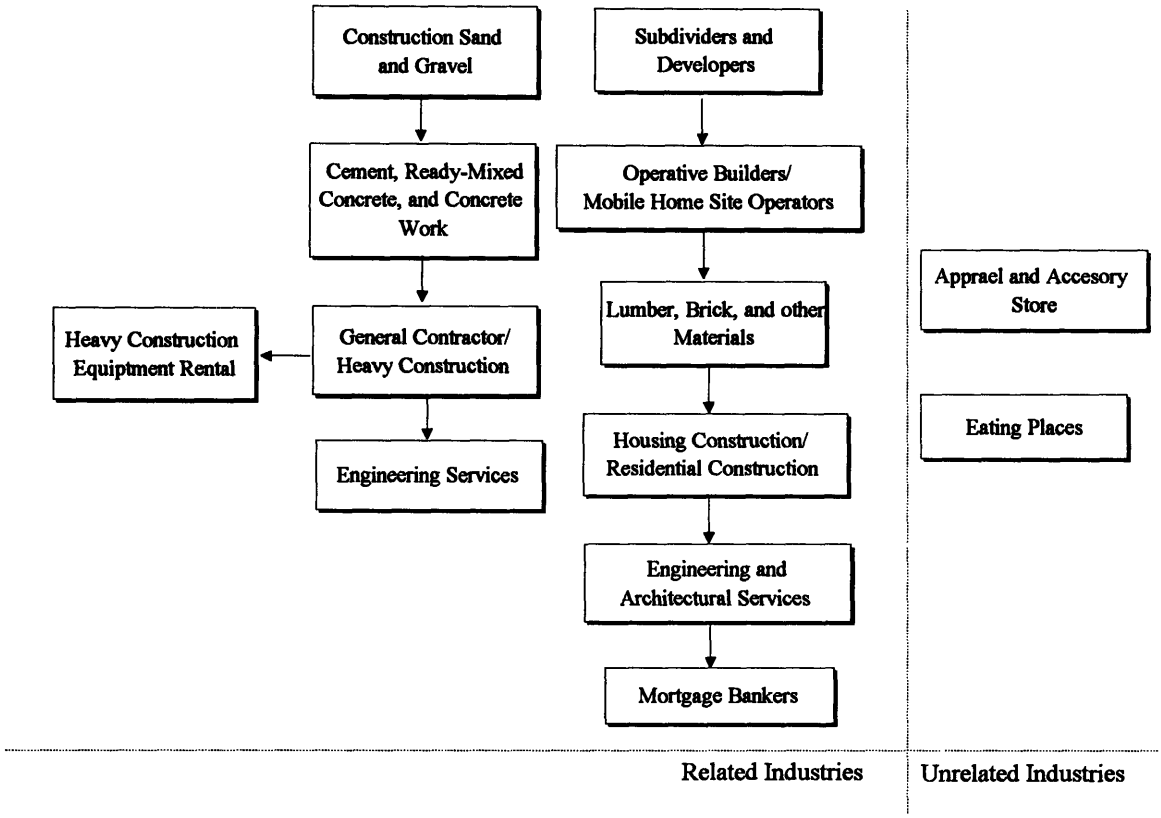


Fig. 3.2 Product Flow of Centex Corp.,1993
Source: America's Corporate Families, 1994

3.4 RESULTS OF CLASSIFICATION

In section 3.1 there were one hundred U.S. construction firms selected as the sample for measuring the diversity status. However, eight companies of them are private ones or subsidiaries so that their financial data are not available. Therefore, in this research only ninety-two firms' ratios were computed and then classified. The ratios and their diversification strategies are shown in Table 3.5.

Table 3.4 Diversification Status of U.S. Construction Industry, 1993

Diversification Strategy	Number of Firms	Percentage
Dominant-Constrained	1	1.09
Dominant-Vertical	12	13.04
Related-Constrained	43	46.74
Single-Business	11	11.96
Unrelated-Business	25	27.17

From Table 3.5, the distribution of diversification strategies in U.S. construction industry can be expressed as in Table 3.6. Almost forty-seven percent of firms in the sample belong to the RC (related-constrained) diversification strategy group. This results show that, till 1993, almost half of U.S. construction firms have diversified their businesses into related industry, and one fourth diversified into unrelated fields. SB (single-business) and dominant strategies seemed unpopular by managers, since the percentage of each of DC, DV, and SB is very low.

Table 3.5 The Ratios and Diversification Strategies of the Sample of Construction Firms

No	Firm	Type	SR	RR	VR	Diversification Strategy
1	Covington Development Group In	P	0.784	0.978	0.000	Dominant Constrainted
2	Forest City Enterprises Inc	P	0.751	1.000	0.877	Dominant Vertical
3	Hovnanian Enterprises Inc	P	0.313	0.778	0.778	Dominant Vertical
4	Jacobs Engineering Group Inc	P	0.507	0.988	0.938	Dominant Vertical
5	Starret Housing Corp	P	0.293	0.994	0.909	Dominant Vertical
6	Turner Corp	P	0.200	1.000	0.736	Dominant Vertical
7	Williams Industries Inc	P	0.302	0.877	0.753	Dominant Vertical
8	Bechtel Grooup Inc	R	0.315	0.991	0.960	Dominant Vertical
9	Boldt Group Inc	R	0.392	0.792	0.792	Dominant Vertical
10	Gilbane Building Cos	R	0.360	1.000	0.989	Dominant Vertical
11	Kitchell Corp	R	0.263	0.822	0.822	Dominant Vertical
12	Lincoln Property Corp	R	0.200	1.000	0.800	Dominant Vertical
13	Parsons Corp	R	0.448	0.999	0.940	Dominant Vertical
14	Abrams Industries Inc	P	0.247	0.723	0.000	Related Constrainted
15	Acmat Corp	P	0.192	1.000	0.000	Related Constrainted
16	Amelco Corp	P	0.539	1.000	0.000	Related Constrainted
17	Amre Inc	P	0.266	0.712	0.000	Related Constrainted
18	Atkinson Guy F. Co of California	P	0.167	0.922	0.000	Related Constrainted
19	Centex Corp	P	0.301	0.893	0.490	Related Constrainted
20	Chempower Inc	P	0.533	0.826	0.000	Related Constrainted
21	Continental Homes Holding Corp	P	0.291	0.720	0.000	Related Constrainted
22	CRSS Inc	P	0.157	0.959	0.592	Related Constrainted
23	Eastern Environmental Services In	P	0.681	0.773	0.000	Related Constrainted
24	ECI Environmental Inc	P	0.536	1.000	0.000	Related Constrainted
25	Fairfield Communities Inc	P	0.205	0.783	0.000	Related Constrainted
26	Fluor Corp	P	0.338	0.882	0.467	Related Constrainted
27	Granite Construction Inc	P	0.250	0.917	0.000	Related Constrainted
28	Halliburton Co Inc	P	0.213	0.778	0.675	Related Constrainted
29	Handex Environmental Recovery I	P	0.488	0.952	0.000	Related Constrainted
30	Heist C H Corp	P	0.259	0.745	0.000	Related Constrainted
31	Insituform Mid-America Inc	P	0.563	0.963	0.000	Related Constrainted
32	Irex Corp	P	0.183	0.878	0.000	Related Constrainted
33	Kasler Corp	P	0.552	1.000	0.000	Related Constrainted
34	Kaufman and Broad Home Corp	P	0.451	0.792	0.000	Related Constrainted
35	LE Myers Company Group	P	0.500	1.000	0.000	Related Constrainted
36	Morrison Knudsen Corp Delware	P	0.192	0.973	0.589	Related Constrainted
37	Perini Corp	P	0.169	0.995	0.546	Related Constrainted
38	Rouse Co	P	0.541	0.890	0.000	Related Constrainted
39	Toll Brothers Inc	P	0.290	0.703	0.000	Related Constrainted
40	UDC Homes Inc	P	0.537	0.901	0.000	Related Constrainted
41	Webb (Del) Corp	P	0.410	1.000	0.000	Related Constrainted
42	Alberici Corp	R	0.210	1.000	0.000	Related Constrainted
43	Austin Industries Inc	R	0.278	1.000	0.000	Related Constrainted
44	Baugh Enterprises Inc	R	0.561	0.998	0.000	Related Constrainted
45	Clark Construction Group Inc	R	0.496	0.948	0.000	Related Constrainted
46	Dillingham Construction Corp	R	0.234	0.996	0.000	Related Constrainted

Table 3.5 The Ratios and Diversification Strategies of the Sample of Construction Firms (continue

No	Firm	Type	SR	RR	VR	Diversification Strategy
47	Eby Corp	R	0.230	1.000	0.000	Related Constrainted
48	Harbert Corp	R	0.178	0.889	0.000	Related Constrainted
49	Kiewit Peter Sons Inc	R	0.184	0.704	0.000	Related Constrainted
50	MA Mortenson Co	R	0.500	1.000	0.000	Related Constrainted
51	McCarthy Holding Co	R	0.404	1.000	0.000	Related Constrainted
52	Pepper Companies Inc	R	0.520	1.000	0.000	Related Constrainted
53	Performance Contracting Group I	R	0.483	1.000	0.000	Related Constrainted
54	Sundt Corp	R	0.246	0.859	0.476	Related Constrainted
55	Fischbach Corp	S	0.188	1.000	0.668	Related Constrainted
56	United Engineers and Constructors	S	0.308	1.000	0.637	Related Constrainted
57	American Dredging Co	P	0.964	0.964	0.000	Single Business
58	Calton Inc	P	1.000	1.000	0.000	Single Business
59	Engle Homes Inc	P	1.000	1.000	0.000	Single Business
60	General Homes Corp	P	0.992	1.000	0.000	Single Business
61	Insituform East Inc	P	0.981	0.981	0.000	Single Business
62	Offshore Pipelines Inc	P	0.962	0.962	0.000	Single Business
63	Standard Pacific Corp	P	0.970	0.970	0.000	Single Business
64	Universal Medical Building L.P.	P	1.000	1.000	0.000	Single Business
65	Baker Concrete Construction Inc	R	1.000	1.000	0.000	Single Business
66	Beers Inc	R	1.000	1.000	0.000	Single Business
67	Monumental Investment Corp	R	0.999	1.000	0.000	Single Business
68	Amrep Corp	P	0.378	0.562	0.000	Unrelated Business
69	Apogee Enterprises Inc	P	0.452	0.247	0.000	Unrelated Business
70	Blount Inc	P	0.179	0.683	0.000	Unrelated Business
71	CBI Industries Inc	P	0.292	0.649	0.000	Unrelated Business
72	Enserch Corp	P	0.275	0.553	0.539	Unrelated Business
73	Enviroq Corp	P	0.609	0.614	0.000	Unrelated Business
74	Foster Wheeler Corp	P	0.328	0.686	0.600	Unrelated Business
75	JWP Inc	P	0.363	0.389	0.223	Unrelated Business
76	Kimmins Environmental Service C	P	0.189	0.645	0.000	Unrelated Business
77	LVI Group Inc	P	0.590	0.620	0.000	Unrelated Business
78	McDermott International Inc	P	0.194	0.527	0.397	Unrelated Business
79	NVR Limited Partnership	P	0.323	0.379	0.000	Unrelated Business
80	Ogden Corp	P	0.174	0.318	0.284	Unrelated Business
81	PHM Corp	P	0.297	0.473	0.000	Unrelated Business
82	Pitt-Des Moines Inc	P	0.202	0.357	0.000	Unrelated Business
83	Ryland Group Inc	P	0.346	0.481	0.000	Unrelated Business
84	Seveson Environmental Services I	P	0.258	0.634	0.000	Unrelated Business
85	Team Inc	P	0.255	0.358	0.000	Unrelated Business
86	US Home Corp	P	0.341	0.671	0.000	Unrelated Business
87	Weatherford International Inc	P	0.607	0.187	0.000	Unrelated Business
88	Wheelabrator Technologies Inc	P	0.165	0.440	0.216	Unrelated Business
89	Zurn Industries Inc	P	0.353	0.438	0.000	Unrelated Business
90	Harlan Electric Co	R	0.640	0.640	0.000	Unrelated Business
91	HBE Corp	R	0.343	0.575	0.574	Unrelated Business
92	Marley Co	R	0.513	0.513	0.000	Unrelated Business

CHAPTER 4

RESEARCH DESIGN

4.1 METHODOLOGY

In section 4.1 the methodology used for measuring the relationships between financial performance/risk and diversification strategies of the construction firms, several statistical tools, are introduced, which include: (1) analysis of variance; (2) pairwise comparison; (3) stepwise procedure; (3) multiple regression models.

4.1.1 Analysis of Variance

Analysis of variance (ANOVA) is a technique that the total variation present in a set of data is partitioned into several components. Associated with each of these components is a specific source of variation, so that in the analysis it is possible to determine the magnitude of the contribution of each of these sources to the total variation. The techniques and

concepts of analysis of variance are used most frequently to estimate and test hypotheses about the equality of three or more population means and those data from designed experiments.

We analyze data from an experiment using the completely randomized design by what is known as *one-way analysis of variance*. The term *one-way* means that we classify the experimental units and measurements obtained according to only one criterion - the treatment group to which they belong. Here the treatment is a factor that the experiment controls, while the entity that receives a treatment is called an experimental unit. In fact, one-way ANOVA, used to test for a significant difference among several means, is an extension of the *t*est for the difference between two means.

In this research ANOVA was used to test the hypotheses that there exist significance in ROA and risk among U.S. construction firms of different diversification strategies.

4.1.2 Pairwise Comparison

A pairwise comparison is the difference between two means without regard to the algebraic sign. Before conducting a study, it is necessary to decide if it is worthwhile to compare only certain pairs of sample treatments to see whether they are significantly different. If F value (treatment mean square *divided by* error mean square) computed in ANOVA is no significant, this indicates that there is no evidence of a treatment effect. However, if the computed F value is significant, we are likely to find which pairs of sample treatment means are significantly different.

Tukey's HSD Test

In this research Tukey's HSD (honestly significant difference) test, a procedure that J.W. Tukey (1953) proposed for making all *pairwise* comparisons among means, is adopted. When Tukey's test is used with equal sample sizes, the value HSD is computed to compare all differences. HSD is given by the following formula:

$$\text{HSD} = q_{\alpha,k,n-k}\sqrt{\frac{\text{MSE}}{n_j}}$$

where q is obtained from the Table of Percentage points of the Studentized Range for significance level α, k means in the experiment, and n-k error degrees of freedom. Any difference between pairs of means that exceeds HSD is declared significant. The HSD statistic requires that all sample sizes be equal.

4.1.3 Multiple Regression Model

The multiple linear regression model is as follows

$$y_i = \beta_0 + \beta_1 x_{1j} + \beta_2 x_{2j} + \beta_3 x_{3j} + \cdots\cdots + \beta_k x_{kj} + e_j$$

where y_i is a typical value of Y, the dependent variable from the population of interest; β_0, β_1, ..., β_k are the population *partial regression coefficients*; and x_{1j}, x_{2j},....., x_{kj} are observed values of the independent variables X_1, X_2,....., X_k, respectively. Here Y is a linear function of the k independent variables, .

In multiple regression model, there are some necessary assumptions:

(1) X_i may be either random or fixed variables, and are referred to as *predictor variables*, because of their role in predicting Y.

(2) X_i are measured without error. And for each combination of X_i values, there is a normally distributed subpopulation of Y values. The variances of the subpopulation of Y values are all equal.

(3) Y values are independent. and The e_i are normally and independently distributed, with mean 0 and variance σ^2.

To evaluate the multiple regression equation for prediction and estimation, the *coefficient of multiple determination* is used. This coefficient provides an overall measure of the adequacy of the equation and tells what proportion of the total variability in Y, the dependent, is explained by the independent variables. It is defined as

$$R^2_{y.12...k} = 1 - \frac{\sum(y_j - \hat{y}_j)^2}{\sum(y_j - \bar{y}_j)^2} = \frac{SSR}{SST}$$

The numerator of the middle term is the explained sum of squares, or the *sum of squares due to regression*, SSR. The denominator is the total sum of squares, SST. The subscript on R^2 indicates that Y is the dependent variable and X_1, X_2,....., X_k are independent variables.

Besides those quantitative independent variables, it is desirable to use one or more qualitative variables as independent variables in the regression model to convey the concept of attribute. Dummy variables are used to solve the problem. A dummy variable is a variable that assume only a finite number of values (such as 0 or 1) for the purpose of identifying the different categories of a qualitative variable. A qualitative variable with *k*

categories requires k - 1 dummy variables. In this research, to measure the relationships between a construction firm's return/risk and five diversification strategies, four dummy variables, DV, RL, RC, and SB are used.

4.1.4. Stepwise Procedure

In this research, at first there are thirty-seven variables considered for placing in the multiple regression models. Except for the two dependent variables: ROA (return on assets) and Risk (variance of ROA over a period 1989-1992), and the four dummy variables that are fixed for measuring the difference between construction firms' return/risk and diversification strategies cannot be dropped, the other thirty-one variables were filtered and at last there are only ten left for regression models. The tool adopted here is stepwise regression, a widely used strategy for selecting independent variables for a multiple regression model.

At each step of stepwise procedure, each variable in the model is evaluated to see if, according to specified criteria, it should remain in the model. The flow chart of stepwise procedure in shown in Figure 4.1. In this research the cutoff and removal value are F-enter = 4, and F-remove = 0, respectively.

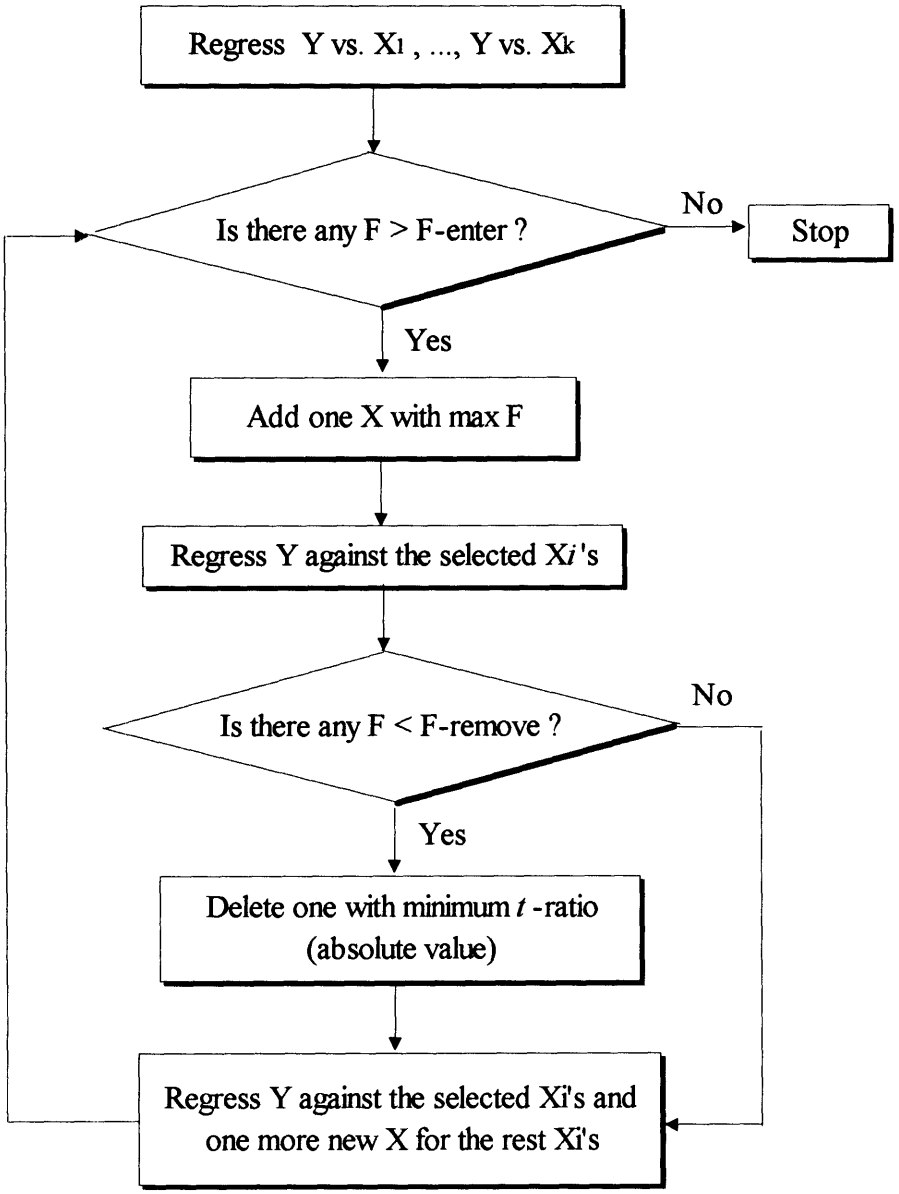


Fig. 4.1 The Flow Chart of Stepwise Procedure

Source: Notes of Applied Statistics, Bin Zhou

4.2 MULTIPLE REGRESSION

4.2.1 Analysis of Variance

According to the results of classification of chapter 3.4, there is only one construction firm falling in the group of DC (dominant-constrained) diversification strategy. To avoid the possible errors appearing in the regression analysis due to the lack of data, this company was omitted from the sample. In addition, among the ninety-two sample construction firms selected in chapter 3, there were only sixty public companies of which the complete financial data over the period 1989-1992 were available, this research only used those sixty firms as a sample to proceed the regression analysis and avoid the errors from the imperfect data. Therefore, there are four diversification strategy groups for regression analysis: DV, RC, SB, and UB.

By using SPSS® for Windows™ Release 6.0.1 Student Version, a statistical computer package, the author computed the variance of the dependent variables, Return On Assets (ROA) and Risk. These results are shown through Table 4.1 to Table 4.4.

According to Table 4.1 and Table 4.2, it is found that, at 0.05 level, there exists significant difference in both ROA and Risk among these classification groups. After the initial analysis of variance, the method pairwise comparison is used to compare the difference between these means without regard to the algebraic signs. As described in section 4.1, the Tukey's HSD (honestly significant difference) test is adopted in this research, and the results are shown in Table 4.3 and Table 4.4.

In Tukey's HSD test, the difference between two means is significant if

$$\text{MEAN}(j) - \text{MEAN}(i) \geq 0.0229 \times \text{RANGE} \times \sqrt{\frac{1}{\text{N}(i)} + \frac{1}{\text{N}(j)}}$$

Table 4.1 Analysis of Variance: ROA (Return on Assets)

Source	Degree of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	4	.0219	.0055	5.1846	.0013
Within Groups	55	.0581	.0011		
Total	59	.0800			

Table 4.2 Analysis of Variance: Risk

Source	Degree of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Between Groups	4	.0124	.0031	2.2106	.0797
Within Groups	55	.0769	.0014		
Total	59	.0893			

Table 4.3 Results of Tukey's HSD test: ROA (Return on Assets)

Mean		DV	RC	SB	UB
-.0118	DV				
.0224	RC	*			
.0384	SB	*			*
.0534	UB				

Note: 1. RANGE: 3.99

2. (*) Indicates significant differences which are shown in the lower triangle

Table 4.4 Results of Tukey's HSD test: Risk

Mean		DV	RC	SB	UB
.0060	DV				
.0317	RC				
.0657	SB	*			
.0361	UB				

Note: 1. RANGE: 3.99

2. (*) Indicates significant differences which are shown in the lower triangle

The results of the test for each type of classification are as follows:

The results above imply that, in the 4-year period 1989-1992, the financial performance differences are significant between RC firms and DV firms, SB firms and DV firms, and SB firms and UB firms. On the other hand, the significant difference of risk exists between SB firms and DV firms.

4.2.2 Hypotheses

4.2.2.1 The Risk Impacts on Diversification

According to the study of Bettis and Hall (1982), any diversification move will affect a firm's risk-return profile. Those factors which would cause the results include:

(1) Changes in industry-specific risk.

(2) Changes in the size of the firm.

(3) Changes in the number of business within the firm.

(4) Changes in the degree of relatedness among the set of business.

However, a firm can diversify into less risky product markets (e.g. less variation in industry demand or profits) or can withdraw from high-risk business to reduce the risk of the firm. Successful diversification moves can lead to an increase in firm assets. Through efficient transfer of resources, the external risk could be absorbed. Larger firms often tend to have less risky profiles. The more a firm diversifies, the more it can spread industry-specific risk. And the risk can be reduced if the new business are little or negatively correlated with existing business.

Therefore, through the cross-sectional analysis we can infer that the risk associated with diversification strategy would depend upon:

(1) The risks of the industries in which the firm involves.

(2) The number of the industries in which the firm operates.

(3) The size of the firm.

(4) The generic diversification strategy that the firm chooses.

In this research the author adopted the classification system by Rumelt (1974). In terms of the correlation of risk between two businesses, high relatedness would mean high business risk, or industry risk, since these businesses share some common factors and sources of uncertainty, and consequently face similar risk. On the other hand, high unrelatedness would indicate a diverse set of sources of uncertainty, and therefore indicate potential for significant risk reduction. The more debt a firm has usually means the more risk it is operating with.

From the argument the following risk relationships can be hypothesized:

$$RISK_{SB} > RISK_{DV} > RISK_{RC} > RISK_{UB}$$

Therefore, the previous discussion about risk modeling and strategy leads to the following hypotheses:

Hypothesis 1: A diversified firm's risk is positively associated with the risk of its product markets.

Hypothesis 2: A diversified firm's risk is negatively associated with the size of the firm and its net sales.

Hypothesis 3: A diversified firm's risk is negatively associated with the number of businesses it operates in.

Hypothesis 4: The risk associated with generic diversification strategy in the following order:

$RISK_{SB} > RISK_{DV} > RISK_{RC} > RISK_{UB}$

Where the description of the subscripts are defined as follows

Symbol	*Diversification Strategy*
SB	Single Business
DV	Dominant Vertical
RC	Related Constrained
UB	Unrelated Business

4.2.2.2 Diversification Strategies and Firms' Return

Rumelt (1982) and Bettis and Hall (1982) proposed that the existence of industry effects on the profitability of the individual firm. Rumelt also stressed the economic efficiency advantage of the related-linked strategy, and over unrelated strategies. In addition, since diversification is a growth strategy, the size effect should be also considered. When firm size is controlled, then high diversity should result in a low average market share of each business and fail to achieve economies of scale; therefore, high diversity (large number of business) will be associated with lower profitability. Papelu (1984), using the Jacquemin-Berry entropy measure of diversification and the line-of-

business data, also found that firms with predominantly related diversification show significantly better profit than firms with predominantly unrelated diversification. Besides, Bettis and Maharani (1985) proposed that related diversification is a necessary but not sufficient condition to achieve a favorable risk/return performance. Firms in efficient clusters (relative high performance at a medium level) tend to be in high growth industries and have relatively lower level of debt financing.

According to Brealey and Myers (1991), a firm with a low ratio of the average collection period which measures the speed that customers pay their bills, is believed to indicate an efficient collection department. As for the current ratio and quick ratio, they roughly measure the potential reservoir of the company. Managers sometimes would look at the rate at which companies turn over their inventories. A high inventory turnover is often regarded as a sign of efficiency. To measure the performance of the firms, return of assets, return on investment, and return on equity are usually used. Higher ratios indicate better profitability of the firm.

To summarize, the hypotheses on the relationship between components of diversification strategy and return are as follows:

Hypothesis 5: A diversified firm's return is positively associated with the return of its product markets.

Hypothesis 6: A diversified firm's return is positively associated with the size of the firm.

Hypothesis 7: A diversified firm's return is negatively associated with the number of business it operates in.

Hypothesis 8: The return associated with generic diversification strategy in the following order:

$$RETURN_{SB} > RETURN_{DV} > RETURN_{RC} > RETURN_{UB}$$

Hypothesis 9: A diversified firm's return is negatively associated with the length of the average collection period.

Hypothesis 10: A diversified firm's return is negatively associated with the length of the time to sell its inventory.

Hypothesis 11: A diversified firm's return is positively associated with its total net sales.

Hypothesis 12: A diversified firm's return is negatively associated with its total debt.

4.2.2.3 The Curvilinear Relationship between Risk and Return

The earlier discussion of recent developments in the behavior analysis of risky decisions suggests the following hypotheses:

Hypothesis 13: A U-shaped curvilinear relationship exists between risk and return.

That is, risk is negatively associated with return and positively associated with the square of the return variable if the effects of such variable as diversification strategy are controlled in the analysis. In conventional expectation the positive relationship exists because of diversification (i.e. low risk - low return of unrelated firms and high risk - high return of related-constrained firms).

The positive relationship is based on the assumptions:

(1) All businesses in a firm's portfolio are independent of each other.

(2) The considerations of the behavior do not affect the decisions of managers.

(3) Efficient factor market exists.

4.2.3 Design of Regression Models

4.2.3.1 Variable Selection and Data Collection

Since the goal of this research is to explore the relationships of the financial performance and risk of the U.S., here the dependent and independent variables which the author selected are from or related to firms' public financial reports, such as income statements, balance sheets, and those relevant to their stock prices. The sources of these data include: (1) Compustat PC Plus, (2) Moody's Handbooks of Public Companies. All the data collected from the source are within the 4-year period 1989-1992.

According to the hypotheses of 4.2.2, there were 37 variables in total are considered to put into the multiple regression models. These variables are shown in Table 4.7, and their definitions are arranged in Appendix I. In addition, Appendix II also shows the financial data of these variables of the sample firms.

4.2.3.2 Model Specification

Hypotheses 1 and 9 were tested by two regression equations. Zellner and Theil (1971) indicated that a joint estimation of the set equations using generalized least squares results in more efficient estimates than OLS (ordinary least square method) equation by equation. In this research, it would be improper to use simultaneous-equation regression, since the two dependent variables are statistics computed from the same set of data. That is, both

Table 4.5 Variables for the Stepwise Procedure of Regression Analysis

NO	VARIABLE	ITEM	UNIT
1	ANUL_SAL	Ave. Annual Sales	US$ Dollar
2	AVE_COLP	Average Collection Period	Day
3	CF_PSHR	Cash Flow Per Share	US$ Dollar
4	CUR_R	Current Ratio	Ratio
5	SELL_INV	Days to Sell Inventory	Day
6	DIV_PYOT	Dividend Payout	%
7	DIV_YILD	Dividend Yield	%
8	IN_CV_AT	Interest Coverage After Tax	Ratio
9	IN_CV_BT	Interest Coverage Before Tax	Ratio
10	INV_TR	Inventory Turnover	Decimal
11	LOG_SAL	Log (Ave Annual Sales)	Decimal
12	SIZE	Log (Ave Assets)	Decimal
13	LTD_SEQT	Long-Term Debt/Shareholders' Equity	%
14	NB	No of Business	Decimal
15	EMPL	No of Employees	1,000
16	OP_CYC	Operating Cycle	Day
17	OPM_A_DP	Operating Margin After Depreciation	%
18	OPM_B_DP	Operating Margin Before Depreciation	%
19	PM_B4_TX	Pretax Profit Margin	%
20	QUICK_R	Quick Ratio	Ratio
21	REC_TR	Receivable Turnover	Decimal
22	ROA	Return on Assets	%
23	RISK	Risk; Variance of ROA in a 4-year Period	Decimal
24	ROA_SQR	ROA^2	Decimal
25	SAL_NPR	Sales/Net Property, Plant & Equip	Ratio
26	SAL_SEQT	Sales/Stockholders' Equity	Ratio
27	TATR	Total Asset Turnover	Ratio
28	TAS_CEQT	Total Assets/Common Equity	Ratio
29	T_DB_INC	Total Debt/Invested Capital	%
30	TDB_TAS	Total Debt/Total Assets	%
31	WIRN	Weighted Industry Return	Decimal
32	WIRK	Weighted Industry Risk	Decimal
33	WC_PSHR	Working Capital Per Share	US$ Dollar
34	DV	Dummy Variable	0 or 1
35	RC	Dummy Variable	0 or 1
36	SB	Dummy Variable	0 or 1

risk and return measures are computed from the same 4-year ROAs. Besides, most empirical studies on risk and return have provided theoretical explanations based on the assumptions that either risk or return is endogenous. There are also technical difficulties in the specification on simultaneous regression model of risk and return. In single equation regression, it can be assumed that the error terms are identically and normally distributed. However, in simultaneous regression, the nature of risk and return measures would lead to non-normal distributions for the error terms.

As described in section 4.1, the author adopted the strategy, stepwise procedure, for selecting independent variables for a multiple regression model. By using the stepwise procedure of SPSS® for Windows™ Release 6.0 Student Version with the entrance F probability = 0.10 and the removal F probability = 0.15, among these 36 variables of interests are there 10 chosen as independent for the two regression models: LOG_AST, ROA, ROA_SQR, TATR, WIRK, WIRN, AVE_COLP, SAL_SEQT, SELL_INV and TDB_TAS.

Then, assuming the relationships are linear except the relationship between risk and return, the two regression equations are specified as follows:

$$\begin{aligned}\mathrm{RISK}_i &= a_0 + a_1\mathrm{WIRK}_i + a_2\mathrm{SIZE}_i + a_3\mathrm{ROA}_i + a_4\mathrm{ROA}_i^2 + a_5\mathrm{TATR}_i + a_6\mathrm{NB}_i \\ &\quad + a_7\mathrm{DV}_i + a_8\mathrm{RC}_i + a_9\mathrm{SB}_i + e_i\end{aligned}$$

$$\begin{aligned}\mathrm{ROA}_i &= b_0 + b_1\mathrm{WIRN}_i + b_2\mathrm{SIZE}_i + b_3\mathrm{RISK}_i + b_4(\mathrm{AVE\_COLP}_i) + b_5(\mathrm{SAL\_SEQT}_i) \\ &\quad + b_6(\mathrm{SELL\_INV}_i) + b_7(\mathrm{TDB\_TAS}_i) + b_8\mathrm{NB}_i + b_9\mathrm{DV}_i + b_{10}\mathrm{RC}_i + b_{11}\mathrm{SB}_i + e_i\end{aligned}$$

The explanations and definitions of each variable are shown in Table 4.6.

In both equations the explanatory variables associated with diversification are weighted industry risk (WIRK), weighted industry return (WIRN), SIZE, and four dummy variables for generic diversification strategies: DV for dominant-vertical, RC for related-constrained, RL for related-linked, and SB for single-business strategy. The positive/negative status of the coefficients of the variables in two multiple regression equations and the relationships
between the coefficients and the hypotheses are shown in Table 4.7 and Table 4.8. The third explanatory variable in the ROA equation, RISK, is designed to test for the existence of risk premia in corporate returns. And the error terms in both equations are assumed uncorrelated between different firms.

This test assumes that after the effects of diversification strategy are removed, the risk residuals will reflect managerial attitude toward risk. And in the Risk equation the attitude toward risk is assumed to respond to corporate return. The range of regression models were formulated as following:

(1) Change in ROA = f (change in market return, change in product diversification, change in sales, change in debt, change in the periods of selling inventory, change in collection period, change in assets)

(2) Change in Risk = f (change in market risk, change in product diversification, change in net sales, change in assets)

Table 4.6 The Variables of Multiple Regression Models

Variable	Explanation	Definition
$RISK_i$	Corporate risk of firm *i*	Variance of ROA over the 4-year period 1989-1992
ROA_i	Corporate return of firm *i*	Mean value of return on assets over the 4-year period 1989-1992
ROA_i^2	Square Value of ROA_i	
$WIRK_i$	Weighted industry risk for firm *i*	Industry risk measured at four-digit SIC code level
$WIRN_i$	Weighted industry return for firm *i*	Industry return measured at four-digit SIC code level
$SIZE_i$	Size of firm *i*	Logarithm of mean assets of firm *i* over the 4-year period 1989-1992
$TATR_i$	Total Assets Turnover of firm *i*	See Appendix I
$(AVE\_COLP)_i$	Average Collection Period of firm *i*	See Appendix I
$(SAL\_SEQT)_i$	(Sales/Stockholders' Equity) of firm *i*	See Appendix I
$(SELL\_INV)_i$	Days to Sell Inventory of firm *i*	See Appendix I
$(TDB\_TAS)_i$	(Total Debt/Total Assets) of firm *i*	See Appendix I
NB_i	Number of four-digit SIC code industries in firm *i*	
DV_i	Dummy variable	DV = 1 for dominant-vertical firms DV = 0 for other firms
RC_i	Dummy variable	RC = 1 for related-constrained firms RC = 0 for other firms
SB_i	Dummy variable	SB = 1 for single-business firms SB = 0 for other firms
e_i	Error terms	

Table 4.7 The Characteristics of the Coefficients of the Risk Equation

Coefficient	Variables	Predicted Status	Relationships with Hypothesis
a_1	Weighted industry risk (WIRK)	Positive	Indicates industry effects (Hypothesis 1) and diversity (number of business) effects (Hypothesis 3)
a_2	SIZE	Negative	Hypothesis 2
a_3	ROA	Negative	Hypothesis 13
a_4	ROA^2	Positive	Hypothesis 13
a_5	TATR	Negative	Hypothesis 2
a_6	NB	Negative	Hypothesis 3
a_7	Dummy variable (DV)	Positive	Hypothesis 4
a_8	Dummy variable (RC)	Positive	Hypothesis 4
a_9	Dummy variable (SB)	Positive	Hypothesis 4

Table 4.8 The Characteristics of the Coefficients of the ROA Equation

Coefficient	Variables	Predicted Status	Relationships with Hypothesis
b_1	Weighted industry return (WIRN)	Positive	Indicates industry effects (Hypothesis 5) and diversity (number of business) effects (Hypothesis 7)
b_2	SIZE	Positive	Hypothesis 6
b_3	RISK	Positive	Hypothesis 13
b_4	AVE_COLP	Negative	Hypothesis 9
b_5	SAL_SEQT	Positive	Hypothesis 11
b_6	SELL_INV	Negative	Hypothesis 10
b_7	TDB_TAS	Negative	Hypothesis 12
b_8	NB	Negative	Hypothesis 7
b_9	Dummy variable (DV)	Positive	Hypothesis 8
b_{10}	Dummy variable (RC)	Positive	Hypothesis 8
b_{11}	Dummy variable (SB)	Positive	Hypothesis 8

4.3 RESULTS OF MULTIPLE REGRESSION ANALYSIS

The results of the multiple regression are reported as follows. Both equations resulted from the stepwise procedure of the SPSS® for Windows™. The brief description is as follows.

In the Risk equation, the coefficients of SIZE, ROA, ROA^2, TATR, DV, and SB are statistically significant, while the rest of these variables have insignificant coefficients. The significance of the SIZE and the TATR coefficients leads to the acceptance of Hypothesis 2 that the larger scale and the more net sales a firm can achieve, the less risk it will operate the businesses with. The high significance of ROA and ROA^2, based on the hypothesis of a curvilinear association between risk and ROA confirms Hypothesis 13 and suggests that at higher levels of return (compared to other firms and adjusted by market differences), managers will take more risky actions, for either they feel safe to do so or they can afford the risk. On the other hand, while at lower levels of return (negative return, for example), managers will also take more risky actions which reflect the gambling attitudes they may have, or the results of escalating commitment. The U-shaped relationship is consistent with the propositions of Kahneman and Tversky's (1979) prospect theory. The significant coefficients of dummy variables SB and DV indicates that changing the generic diversification strategies of single-business, dominant-vertical, and unrelated-business will affect the risk profiles of construction firms; while the insignificant coefficients of RC and RL lead to the concept that although changing the diversification strategies of related-constrained and related-linked will influence the risk of firms, the effects are not so

substantial as when compared with size effects and net sales. In addition, the insignificance of the coefficients of WIRK and NB goes that the market effects and number of businesses are not as the diversity and size effects.

4.3.1 The Risk Equation

$$RISK = 0.0780 - 0.0128\ WIRK - 0.0080\ SIZE - 0.0875\ ROA + 4.7493\ ROA^2 - 0.0043\ TATR + 0.0068\ NB - 0.0168\ DV + 0.0119\ RC + 0.0211\ SB$$

Characteristics (Risk Equation):

Multiple R	0.92390
R Square	0.85359
Adjusted R Square	0.83701
Standard Error	0.01571
Number of Firms	60

ANOVA Table of Risk Equation

Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	6	.07623	.01270	51.49887	0.0000
Residual	53	.01307	.00025		
Total	59				

Coefficients and T Values of Variables (Risk Equation)

Variable	Coefficient	T Value	Significant T	
(Constant)	0.078004	3.757	0.0004	
WIRK	-.0128000	-0.223	0.8245	
SIZE	-0.007979	-2.252	0.0285	**
ROA	-0.087521	-1.688	0.0973	*
ROA^2	4.749312	12.489	0.0000	***
TATR	-0.004260	-1.831	0.0727	*
NB	0.006808	0.116	0.9079	
DV	-0.016762	-2.252	0.0285	**
RC	0.011851	-0.217	0.8289	
SB	0.021065	3.132	0.0028	***

*** Significant at 0.01 level; ** significant at 0.05 level; * significant at 0.1 level.

4.3.2 The ROA Equation

$$ROA = 0.0701 + 0.5543\ WIRK + 0.0099\ SIZE - 0.0835\ RISK$$
$$- 8.4405*10^{-5}\ AVE\_COLP + 5.9459*10^{-5}\ SAL\_SEQT$$
$$- 6.5909*10^{-4}\ SELL\_INV - 0.0412\ TDB\_TAS - 0.0266NB - 0.0226\ DV$$
$$+ 0.019956\ RC + 0.0213\ SB$$

Coefficients and T Values of Variables (ROA Equation)

Variable	Coefficient	T Value	Significant T	
(Constant)	0.070113	3.451	0.0011	
WIRN	0.554275	2.815	0.0070	***
SIZE	0.009913	2.302	0.0255	**
RISK	-0.083473	-0.951	0.3464	
AVE_COLP	-8.44052E-05	-4.214	0.0001	***
SAL_SEQT	5.94595E-05	2.656	0.0106	**
SELL_INV	-6.59095E-04	-3.579	0.0008	***
TDB_TAS	-0.041162	-3.420	0.0013	***
NB	-0.026606	-0.297	0.7676	
DV	-0.022579	-2.080	0.0427	**
RC	0.019956	2.928	0.0051	***
SB	0.021301	1.765	0.0837	*

*** Significant at 0.01 level; ** significant at 0.05 level; * significant at 0.1 level.

As for the regression results for the ROA equation, variable WIRN has a positive and statistically significant coefficient; this finding indicates that market profitability contributes a major portion of a diversified firm's return. The SIZE coefficient is significant and it supports to accept Hypothesis 6. The significant coefficients of AVE_COLP and TDB_TAS support Hypothesis 9 and 12, respectively. These facts

ANOVA Table of ROA Equation

Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F	Significant F
Regression	9	.05717	.00635	13.88769	0.0000
Residual	50	.02287	.00046		
Total	59				

Characteristics (ROA Equation):

Multiple R	0.84514
R Square	0.71427
Adjusted R Square	0.66284
Standard Error	0.02139
Number of Firms	60

imply that the longer the firms need to wait for customers' bills and the more debt they have, the more negative effects will imposed on their return on assets. Moreover, the SAL_SEQT and SELL_INV coefficients are also significant, and thus confirm Hypothesis 10 and 11 which claim that the more net sales and shorter length of selling inventories will benefit the firms. The insignificant NB coefficient suggests that number of businesses doesn't influence firms' return as much as other factors. For those coefficients of dummy variables, three of four are significant, but Hypothesis 8 should be still discussed more detailedly because the coefficient of RL is different from as predicted and that of RC is insignificant.

4.3.3 Residual Plots

According these two equations, the scatter charts of residuals vs. fitted y, the dependent variables, are plotted in Figure 4.2 and 4.3.

Fig. 4.2 Residual Plot (Dependent Variable: Risk)

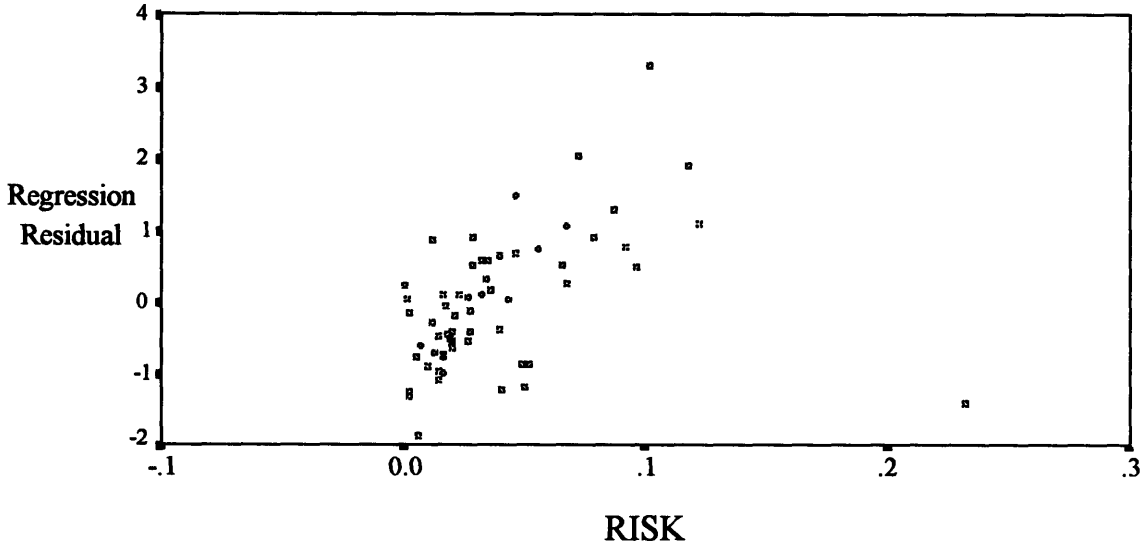
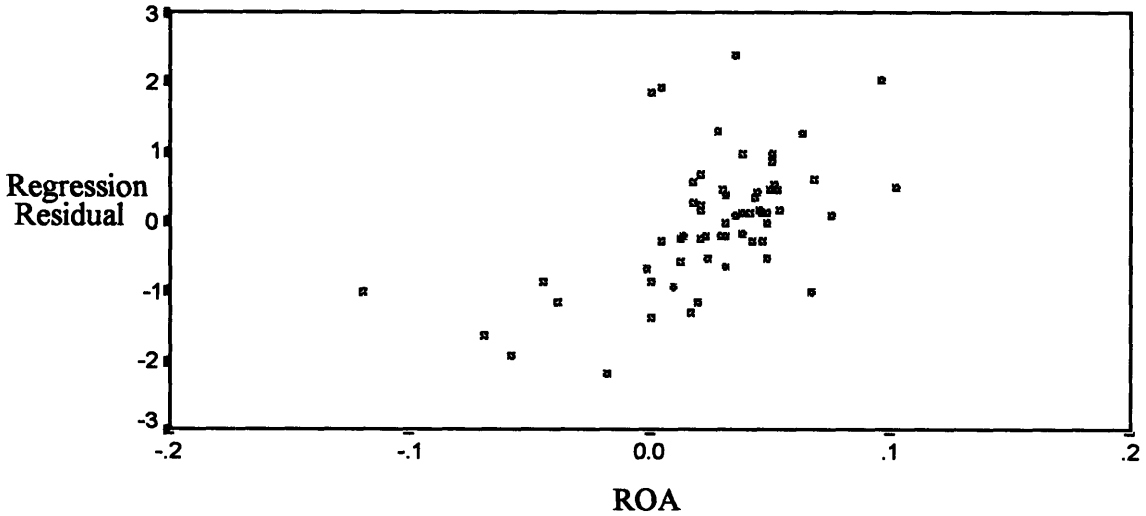


Fig. 4.3 Residual Plot (Dependent Variable: ROA)



CHAPTER 5

DISCUSSIONS AND CONCLUSIONS

5.1 DISCUSSIONS AND CONCLUSIONS

From the adjusted R-square values and F-values of both equations: for Risk equation, 0.83701 and 51.49887, and, for ROA equation, 0.66284 and 13.88769, we can infer that they are significant regression models. The residuals shown in Figure 4.2 and Figure 4.3 also scatter in a fixed range. According the results of multiple regression analysis in Chapter 4, the status of each hypothesis is shown in Table 5.1. This research shows that the risk-return characteristics and the market power which the business units of a diversified firm serve would appear to be the dominating influences on the firm's risk-return profile. Firm size is also associated with better risk-return profiles, while differences in these profiles cannot be attributed to differences in diversification

Table 5.1 Results of Hypotheses

Hypothesis	Status	Hypothesis	Status
1	Rejected	8	Accepted
2	Accepted	9	Accepted
3	Rejected	10	Accepted
4	Rejected	11	Accepted
5	Accepted	12	Accepted
6	Accepted	13	Accepted
7	Rejected		

strategies. The results of Bettis and Mahajan's (1985) study proposed that improved risk-return performance may be achieved through careful formulation of diversification moves-that is, choosing good industries and being strong in them. Diversification does not really change risk-return profiles.

5.1.1 Risk Equation

Although not all coefficients of the generic diversification strategy effects on risk are found to be significant, the signs are still the same as predicted. Construction firms operating with single-business strategies have more risk than other groups, and those operating with dominant-vertical strategies have the least risk. The insignificant impacts of generic diversification strategy on risk may be due to the inability of the dummy variables

to capture the complex correlations among businesses in a firm. The Risk equations of each group are shown as follows:

(1) Dominant-Vertical Strategy:

$$RISK = \mathbf{0.0612} - 0.0128\ WIRK - 0.0080\ SIZE - 0.0875\ ROA + 4.7493\ ROA^2 - 0.0043\ TATR + 0.0068\ NB$$

(2) Related-Constrained Strategy:

$$RISK = \mathbf{0.0899} - 0.0128\ WIRK - 0.0080\ SIZE - 0.0875\ ROA + 4.7493\ ROA^2 - 0.0043\ TATR + 0.0068\ NB$$

(3) Single-Business Strategy:

$$RISK = \mathbf{0.0991} - 0.0128\ WIRK - 0.0080\ SIZE - 0.0875\ ROA + 4.7493\ ROA^2 - 0.0043\ TATR + 0.0068\ NB$$

(4) Unrelated-Business Strategy:

$$RISK = \mathbf{0.0780} - 0.0128\ WIRK - 0.0080\ SIZE - 0.0875\ ROA + 4.7493\ ROA^2 - 0.0043\ TATR + 0.0068\ NB$$

5.1.2 ROA Equation

On the profitability impacts of diversification strategy, the findings of this research are generally consistent with those of Rumelt (1982) and Christensen and Montgomery (1981) in that market effects have the most impact on the profitability of diversified firms. Compared with the study of Montgomery (1985), this research found that firm size can explain the difference of return on assets among these groups, rather than the measure of

market shares. However, when the number of businesses is controlled, firm size can be regarded as an alternate measure for market share, therefore the finding is in line with those of Montgomery (1985).

In addition, the finding which the variable TDB_TAS, ratio of total debts divided by total assets has a significant coefficient suggests that when total assets are controlled, the more debts a firm has, the less its return will achieve. On the other hand, once the debts are held controlled, more total assets will lower the loss of ROA; this is consistent with the effects brought by the variable SIZE.

The coefficient of number of businesses is insignificant, but it still indicates the fact that once a construction firm diversifies its business into different industries, its return will decrease. The significance of average collection period and days to sell inventory implies that they play important roles in the return profiles. Compared to other companies, if a firm has to spend more time waiting for the payments from customers, namely accounts receivable, or selling its inventories, its operating efficiencies would need improvement, and these inefficiencies would damage its profitability.

The ratio, net sales divided by stockholders' equity, is another tool used to measure a firm's operating efficiencies. In ROA equation its coefficient is also significant. When net sales increase with stockholders' equity controlling, the return of a construction firm will grow too.

The equations for each diversification strategy are as follows:

(1) Dominant-Vertical Strategy:

ROA = **0.0475** + 0.5543 WIRK + 0.0099 SIZE - 0.0835 RISK

- $8.4405*10^{-5}$ AVE_COLP + $5.9459*10^{-5}$ SAL_SEQT

- $6.5909*10^{-4}$ SELL_INV - 0.0412 TDB_TAS - 0.0266NB

(2) Related-Constrained Strategy:

ROA = **0.0901** + 0.5543 WIRK + 0.0099 SIZE - 0.0835 RISK

- $8.4405*10^{-5}$ AVE_COLP + $5.9459*10^{-5}$ SAL_SEQT

- $6.5909*10^{-4}$ SELL_INV - 0.0412 TDB_TAS - 0.0266NB

(3) Single-Business Strategy:

ROA = **0.0914** + 0.5543 WIRK + 0.0099 SIZE - 0.0835 RISK

- $8.4405*10^{-5}$ AVE_COLP + $5.9459*10^{-5}$ SAL_SEQT

- $6.5909*10^{-4}$ SELL_INV - 0.0412 TDB_TAS - 0.0266NB

(4) Unrelated-Business Strategy:

ROA = **0.0701**+ 0.5543 WIRK + 0.0099 SIZE - 0.0835 RISK

- $8.4405*10^{-5}$ AVE_COLP + $5.9459*10^{-5}$ SAL_SEQT

- $6.5909*10^{-4}$ SELL_INV - 0.0412 TDB_TAS - 0.0266NB

When other independent variables are controlled, the diversification strategy of single business can bring the most returns of these five groups.

5.1.3 Influence from the Nature of Construction Industry

From the ROA equation, the order of coefficients, SB(+) > RC(+) > DV(-), leads to the following result:

When other independent variables are controlled,

$RETURN_{SB} > RETURN_{RC} > RETURN_{UB} > RETURN_{DV}$

And that of Risk equation is as:

$RISK_{SB} > RISK_{UB} > RISK_{RC} > RISK_{DV}$

Compared with those predicted:

$RETURN_{SB} > RETURN_{DV} > RETURN_{RC} > RETURN_{UB}$

$RISK_{SB} > RISK_{DV} > RISK_{RC} > RISK_{UB}$

In Rumelt's study of 246 companies, RC and RL firms outperformed the other diversification strategies because of the ability to extend their "core skills" (e.g., scientific research) into related area, and RC firms achieved the best return on average, while UB firms produced one of the poorest performance. Bettis (1981) and Palepu (1985) also found that related-diversified firms outperformed unrelated-diversified firms. In their studies, the sample were drawn from all U.S. industries. Therefore, the different outcome of this research may result from the unique nature of construction industry:

(1) The construction industry is a paradox in many ways. It is the largest industry in the U.S. (7.7 percent of GDP, 1992), but most of its hundreds of thousands of participants are small businesses. There are over half a million construction firms in the U.S. These firms are intensely competitive among themselves in the best

traditions of the free enterprise system. Compared with other industries, construction's technological advances sometimes appear trivial. That's the reason for both equations show SB firms have highest ROA and risk.

(2) Although construction industry has many characteristics common to both manufacturing and service industries, such as physical products, the nature of not accumulating significant capital makes it more like a service industry. Success or failure in construction industry is more dependent on the qualities of its people than it is on technologies protected by patents or by the availability of capital facilities.

(3) Construction is highly fragmented and diverse. Each element of construction industry-designers, constructors, regulators, consumers, suppliers, crafts-can be highly skilled in its own area, but there is little general perspective on how all the pieces fit together. Although there was a recession during 1990-1991, the value of publicly owned construction still increased. Therefore, those RC firms operating in public construction fields of highways, water works, conservation and development, and Federal industrial facilities could achieve higher profits and bear lower risks. Also the increasing market share in the international construction industries is another reason for RC firm's high ROA and low risk.

(4) The construction industry is very custom-oriented. This orientation sometimes means the industry is slow to respond to the benefits of mass production. In addition, the construction industry cannot significantly influence the demand for its output or control the supply. The instability of demand results from chronic

seasonality, amplified reaction to basic business, the lack of mobility of resources, and economic cycles. Therefore, there is often too much work in some regions at the same time that others are suffering localized recessions. Because the recent 1990-1991 economic recession occurring in the period 1989-1992, its adverse effects on the construction industry are also reflected in the results:

1. UB firms faced more risky environment for many industries unrelated to construction had more changeable returns;
2. Because of the greater decline in the industries of real estates and construction materials than in traditional construction industries-heavy construction and general contractors, the dominant-vertical firms had the lowest returns. Besides, in such fragmented industries, the benefits from vertical integration's cost advantage surpassed the influence of economic slump and decreased the variance of returns, therefore DV firms could operate with least risks compared with other diversification strategies.

5.1.4 Conclusions

In contrast to a slowly recovering domestic market, those construction firms that ventured into international activities found a thriving and expanding business environment.

Fundamental changes are occurring in the U.S. international engineering and construction industry in the future. Company executives are becoming more aware of opportunities in the global market and so devote a greater proportion of their resources to developing this business. Sensitive to economic downturns in the more developed

economies, they place greater emphasis on project development in those developing countries that have sustained growth. Companies also look for projects in such transition economies as Russia and Eastern Europe.

According to the results of this research, for a manager with characteristics of a risk taker, if he wants to maximize the construction firm's return, the single-business strategy may be a good choice. However, to pursuit a stable growth instead of fast expansion in the changeable global construction markets, the related-constrained diversification strategy would be better. To those risk-adverse managers, the dominant-vertical strategy, which results in lowest risks, could possibly be adopted to help the firms survive in the recession, or even find some niches in the market.

APPENDIX I:

DEFINITIONS OF RUMELT'S CATEGORIES

(1) *Dominant Business:* Any firm which derives 70-94% of its revenues from its largest single business.

Dominant firms were divided into four sub-classifications:

1. *Dominant-Vertical:* Any dominant firm with a higher vertical ratio.
2. *Dominant-Constrained:* Any dominant firm which diversified by building on a single strength or resource associated with the original business.
3. *Dominant-Linked:* Any dominant firm which diversified on the basis of one of several strengths or resources. The particular strength or resource varied across the different businesses in the firm.

4. *Dominant-Unrelated:* Any dominant firm whose diversification activities are not related to the dominant business.

(2) *Related Business:* Any firm deriving less than 70% of its revenues from a single business and possessing a high relatedness ratio.

Related firms were divided into two sub-classifications:

1. *Related-Constrained:* Any related firm which diversified by building a strength or resource associated with the original business.
2. *Related-Linked:* Any related firm which diversified on the basis of one of several strengths or resources. The particular strength or resource varied across the different businesses in the firm.

(3) *Unrelated Business:* Any firm deriving less than 70% of its revenues from a single business and possessing lower relatedness ratios.

Unrelated firms were divided into two sub-classifications:

1. *Acquisitive Conglomerate:* Any unrelated firm over the preceding five years (a) had to have experienced an average growth rate in earnings per share of at least 10 percent per year; (b) had to have made at least five acquisitions, three of which were diversification moves into new business areas unrelated to previous activities; and (c) had to have issued new equity shares whose cumulative market value (taken at the time of issue) was greater than the cumulative value of dividends paid during the same period.
2. *Unrelated-Passive:* Any unrelated firm other than *Acquisitive Conglomerate* firms.

APPENDIX II:

VARIABLE DEFINITIONS AND MEASUREMENTS

1. Ave. Annual Sales:

   Average Annual Revenue of the company over the 4-year period 1989-1992.

2. Average Collection Period:

   Average Collection Period measures the speed with which customers pay their bills. It is computed from average receivables *divided by* average daily sales over the 4-year period 1989-1992.

3. Cash Flow Per Share:

   Cash Flow Per Share is defined as the Total Cash Flow divided by the number of stock shares.

4. Current Ratio:

   Current Ratio is defined as Current Assets-Total which represents cash and other assets that in the next 12 months are expected to realized or used in the production of revenue, *divided by* Current Liabilities-Total, which represents liabilities due within one year, including the current portion of long term debt.

5. Days to Sell Inventory.

6. Dividend Payout:

   Cash Dividends-Common, defined as the total dollar amount of dividends (other than stock dividends) declared on the common stock, *divided by* Income Before Extraordinary Items - Adjusted For Common Stock Equivalents, which represents income before extraordinary items and discontinued operations *less* preferred dividend requirement (adjusted for common stock equivalents).

7. Dividend Yield:

   Dividend Yield-Current Price represents the Current Annual Dividend Rate, which is determined by multiplying the latest dividend paid per share by the number of times it is paid during the year, *divided by* the Current Monthly Close Price.

8. Interest Coverage After Tax:

   Interest Coverage After Tax is defined as Income Before Extraordinary Items, which is the income of a company after all expense, but before provisions for common and/or preferred dividends *plus* Interest Expense, *divided by* Interest Expense, which is defined as the periodic expense to the company if securing short- and long-term debt.

9. Interest Coverage Before Tax:

Pretax Income, defined as operating and non-operating income before provisions for income taxes and minority interest, *plus* Interest Expense, defined as the periodic expense to the company of securing short- and long-term debt, *divided by* Interest Expense.

10. Inventory Turnover:

Cost of Goods Sold *divided by* the average of the current year's Total Inventories and the prior year's Total Inventories.

11. Log(Ave Annual Sales):

Logarithm of average annual sales over the 4-year period 1989-1992.

12. Log(Ave Assets):

Logarithm of mean assets over the 4-year period 1989-1992.

13. Long-Term Debt/Shareholders' Equity:

Total Long-Term Debt, or debt obligations due to more than one year from the company's balance sheet date, *divided by* the sum of Common Equity as Reports, or the common shareholders' interest in the company, *plus* Preferred Stock, of the net number of preferred shares at year-end *multiplied by* the par or stated value per share.

14. No of Businesses:

For each firm, the total number count of three-digit SIC industries is the number of business. The data are drawn from Compustat PC plus and 1992 is used as the base year.

15. No of Empls (1,000):

Number of Employees.

16. Operating Cycle:

Inventory Turnover in days *plus* Accounts Receivable Turnover in days.

17. Operating Margin After Depreciation:

Operating Income After Depreciation *divided by* Net Sales.

18. Operating Margin Before Depreciation:

Operating Income Before Depreciation *divided by* Net Sales.

19. Pretax Profit Margin:

Pretax Profit Margin is defined as Pretax Income which is operating and non operating income before taxes and minority interest, *divided by* Net Sales.

20. Quick Ratio:

The *sum of* Cask and Equivalents, which represents cash and all securities readily transferable to cash, *plus* Total Receivables, which are claims against other collectible in money (within one year), *divided by* Total Current Liabilities, which are liabilities due within one year.

21. Receivables Turnover:

Net Sales *divided by* the average of the current year's Total Receivables, and the prior year's Total Receivables.

22. Return on Assets:

Income Before Extraordinary Items, *divided by* Total Assets, which is defined as the sum of current, net plant, and other noncurrent assets.

23. Risk:

Risk is defined as Variance of ROA in a 4-year Period 1989-1992.

24. ROA^2:

Square of Return On Assets, used to serve as a variable in the regression model of Risk measure.

25. Sales/Net Property, Plant & Equip.

26. Sales/Stockholders' Equity.

27. Total Asset Turnover:

Net Sales *divided by* the average of the current year's Total Assets and prior year's Total Assets.

28. Total Assets/Common Equity.

29. Total Debt/Invested Capital.

30. Total Debt/Total Assets:

The *sum of* Long-Term Debt and Debt in Current Liabilities, *divided by* Total Assets, which represents the *sum of* current assets, net plant, and other noncurrent assets.

31. Weighted Industry Return

(i) *Industry Profitability*: from Compustat PC Plus the Industry Gross Profit Margin at each four-digit SIC industry code level was drawn. The average industry profitability across the 4-year period 1989-1992 represents the mean industry profitability (MIP).

(ii) *Weighted Industry Return:* the mean industry profitability (MIP) for each industry in which diversification firm operates will be multiplied by the fraction of the total net

sales of the firm generated from that industry. The industry information of a diversified firm and its segment sales in that industry are obtained from (a) Million Dollar Director: American's Leading Public and Private Companies. Series, and (b) America's Corporate Families. From these sources, the annual revenues and the four-digit SIC industry to which the revenues belong of each firm's business segment are reported.

For each four-digit industry, the fraction of the total revenues of the firm generated from that industry would be the weight for the calculation of weighted industry return (WIRN). Then the WIRN for a firm is computed from the formula:

$$\text{WIRN} = \sum_{i} W_i \text{MIP}_i$$

where

W_i = weight for four-digit industry$_i$;

MIP_i = mean industry profitability for four-digit industry i.

1992 is the base year for computing the weights.

32. Weighted Industry Risk

(i) *Industry Risk*: this research used relative variation of four-digit industry Return On Assets as a surrogate for industry risk (IRK). The calculation formula is as follows:

IRK = Variance of Return On Assets over a 4-year period 1989-1992

These data are drawn from Compustat PC Plus and Standard & Poor's Register of Corporations Directors and Executives.

(ii) *Weighted Industry Risk*: the weighted industry risk (WIRK) is computed using a method similar to that used in computing weighted industry return (WIRN) except that the square of the weight for each industry is used:

$$WIRK = \sum_{i} W_i^2 IK_i$$

where IK_i is the industry risk for four-digit industry *i*.

As the number of the business increases, the WIRK will decrease due to the square effect of W_i; therefore this variable proxies diversity effects (NB), and industry effects.

33. Working Capital Per Share:

Working Capital, which is the sum of Short-Term or Current Assets and Liabilities, *divided by* the number of stock shares.

34. Diversification Strategy:

The diversification strategy categories of the sample firms have been determined by Rumelt (1982) . In this research, the author used different groups of dummy variables for the two regression models: DV for dominant-vertical, RC for related-constrained, and SB for single-business.

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