Strategic Planning and Control Systems In High Technology Firms

William C. Patterson, Ph.D.

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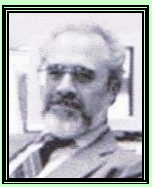

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High technology firms represent a segment of the U.S. economy that is growing in importance domestically and internationally. Managing these kinds of businesses is problematic because of the **high rate of technological change** driving business activity, **complexity of the technology** underpinning business opportunities and threats, and the **context of extreme uncertainty** these and other factors create for strategic decision making. A survey of medium and large firms in the **computer, electrical, and instrumentation industries** reveals the presence of strategic planning and control systems (SPCSs) which emphasize **integrative capability, risk accommodation, technical knowledge focus, organizational learning enhancement, vision projection, and corporate culture salience**. All attributes are positively associated with key internal and external performance factors, except technological knowledge focus. In the latter case, only policies of (1) technologist interaction with customers and (2) involving technologists from diverse specialties in the planning process appear to benefit SPCS effectiveness. Analyses of survey data also indicate the existence of a five-way typology among high technology SPCSs that explains some of the variance in selected performance indicators. In approximate order of their effectiveness, these types are labeled **Technoplanners, Technogeneralists, Technopreneurs, Technovisionaries, and Technoreactors**.

A parallel examination of **technology strategy content** in the **computer industry** focusing on **R&D policy, patenting policy, and plant & equipment policy** reveals significant impacts by these factors on **performance** and **industry structure**, lending some support to an R&D basis for defining high technology enterprise. **Strategic group** structures in the computer industry derived from a **strategy process** (or SPCS) basis bear minimal resemblance to strategic group structures emerging from a technology **strategy content** basis.

Acknowledgements

Many people have provided invaluable guidance and support in helping me to complete this dissertation. I am particularly grateful to Professor John H. Grant who served as my advisor throughout the doctoral program and graciously agreed to chair the dissertation committee. His direction and encouragement were highly instrumental in bringing this project to a successful conclusion. Also, I am deeply indebted to other members of the committee who gave of their valuable time to provide constructive criticism, useful insights, and scholarly advice: Professor Jacob Birnberg, John Camillus, G.G. Hegde, and William Souder.

The exceptional resources of the University of Pittsburgh and the Katz Graduate School of Business also should be acknowledged for their contribution to this effort. I would like to thank John Grant for his generosity in making available the unique resources of the Strategic Management Institute, Susan Neuman and Dennis Smith for helping me to utilize an excellent business library, John Hennon for making resources of the NASA Industrial Applications Center available to me, and Ruchira Sharma for her help in tapping the Compustat database.

If there is anything commendable regarding field expertise and research competence found in this document, much credit goes to the many capable teachers I have had the privilege to study under while a doctoral student at the University of Pittsburgh. This group is comprised of professors Jacob Birnberg, William Dunn, John Grant, James Kenkel, William King, Dundar Kocaoglu, Gershon Mandelker, Raghu Nath, Dung Nguyen, John Prescott, William Souder, Kenneth Pritsker, and James Teng. I thank each one for the knowledge and skill they helped me to acquire.

This research would not have been possible without the cooperation of numerous senior managers who kindly participated in the survey of high technology firms. These are very busy executives with exceptional management responsibilities, and I deeply appreciate their taking a few minutes from their demanding schedules to provide data for this investigation. I sincerely hope that the executive summary of results they subsequently received is viewed as an acceptable return on their investment, and that this research makes the job of navigating their high technology enterprises less problematic.

My hat is off to the organizations, the managers, and the employees of the computer industry and other high technology industries that comprised this study. They are doing

some amazing things with remarkable proficiency that benefit a wide segment of our society. Peering into their world has been a most gratifying experience, and I hope my analysis and results augment in some small way their future success and contributions to the American economic system and way of life.

Special thanks go to family and friends who encouraged me throughout this lengthy process of part-time doctoral study. I am grateful to Velma, Melissa, April, and Jeffrey for sharing me with the University of Pittsburgh over these past nine years. My mother, Eulalia, and father Joseph, also share this accomplishment because values they instilled early in life helped me to successfully complete this very demanding program.

Finally, I would like to thank the Lord for all He has done for me in this endeavor. He has given me a greater love for the pursuit of truth and knowledge, taught me more about the virtues of hard work and perseverance, and opened up exciting new horizons in my life.

As to the flaws that may be found in this finished work, they are solely attributable to me. If I have learned anything from the 28 years I have been formally advancing my education, it is that I am an unfinished work with fathomless capacity for error. Completing the requirements for this doctorate is, indeed, a significant and immensely gratifying career milestone. But I know this achievement leaves me far from perfect. To the extent it has helped me to progress towards artisanship, however, I am most fortunate, for I draw closer to those who find great pleasure in the exercise of their skill, and not just in the completion of tasks.

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1992

The Children

Jeffrey William Patterson
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Electrical Engineering Technology
Summa Cum Laude

April Lynne Patterson
Trinity Christian School
Valedictorian

Melissa Anne Patterson
Trinity Christian School

Foreword to the 2006 Edition

The subject of strategic planning and control systems in high technology firms was topical in 1992, when this thesis was completed in satisfaction of requirements for the degree of doctor of philosophy from the Katz Graduate School of Business, University of Pittsburgh. Fourteen years later, strategic planning and high technology continue to be at the forefront of business and management attention. Issues of national and global competitiveness make it clear that the field of high technology management is quite fertile for research and refinement. The casualty rate among companies, violated career expectations of specialist employees, ascendance of off-shore potencies in high-tech enterprise, and ethical compromises burdening such powerful commerce beckon investment of new character and spirit.

With issuance of this 2006 edition, original research work has been retained largely as was. Added are several **Information Panels** offering Christian Perspectives. They not only invest the thesis with further management wisdom gleaned from a passing decade, but they also provide spiritual insight not invited by the academic qualification process originally engaged. **Key words and phrases** appearing in the text are rendered in bold print for easier entreatment. A **Forward Index** has been added adjacent the Table of Contents to speed *a priori* search for salient terms contributing to understanding of the research. A novel **Instructional Glossary** bridging this work with general understanding in strategy and technology is among appended information. A **Biographical Synopsis** also is appended, including a **Societal Service Matrix** to explicate fitness of personal background to societal need. Vita are far more detailed than is traditional for industry or academia. This accommodates the greater sophistication of scientific service, and reacts to the greater ease and lower cost of electronic archiving. A **Vision of the Future** is given among concluding entries of the **Post Script**. The **Global Environmental Service** and **Priesthood of Science and Technology** are described in Christian context as crowning hope for anticipated millennial peace. Finally, a computerized implementation of the sound principles for strategic planning and control in high technology firms derived from the thesis and packaged as the **Pyramid Strategic Planning and Control System** is introduced. It is hoped that the reduction to practice of scholarly thesis work incorporated in this re-issuance will increase validation of academic research. Research is a constructive intellectual endeavor, faithfully expected to spawn many "children of the mind," well-grounded, well-applied, well-implemented for prospering, resolving futures.

The augmented thesis has been composed for **electronic publication**. Electronic media is the communication signature for the Great High Technology Society. The medium has matchless speed, liberally enables graphic arts expression, facilitates effortless search/research capabilities, confers timeless archivability, and supports literary work with extreme cost efficiency.

Color: Since book covers are unessential in electronic publishing, the electronic thesis package offers compensating artistry through a distinctive, colorful, inspirational **Frontis Graphics Page**. The green color theme was chosen because it is most comfortable to the eye, and also to reflect the author's work in perpetual energy resource development, pivotally centering on Earth's limitless green foliage energy. For easier visual search via down-paging or up-paging, the new **Christian Perspective Information Panels** are rendered in contrasting green tones and sequenced via letters of the Greek alphabet (Alpha, Beta, Gamma, etc.). Similar color coding was given delineative **Colorized Chapter Headings**. Finally, **Colorized Figures and Tables** have been composed to advance artistry in the delivery of voluminous, detailed factual information.

ElectroLinks: Traverse and integrative measures augmenting the thesis include (1) hyperlinks between **literature citations** in the text and specific bibliographic entries, (2) hyperlinks between key strategy and technology terms in the text and the **Instructional Glossary**, (3) hyperlinks between the Table of Contents and **Chapters, Figures, and Tables**.

It is my personal, spirit-led conviction that success in fast-paced, sophisticated, hazardous high technology will return to the U.S. as it makes greater investment in things of God. This field of management is frustrated by problems outpacing solutions, a situation that appeal to higher power can alleviate. Super money, super equipment, and super men cannot do it (some feel the latter already have made their play). However, with God, all things are possible. His advice across millennia is that the Corporate Body of Christ will succeed in every situation, and succeeds eternally. The headship of Christ has been sadly lacking in high technology business strategy for years. Under-rationalizing, hyper-pacing, and over-powering (in predative sense) are contemporary practices, but not divine initiatives. The orderly, gentlemanly, un-exploitive, fully-effective ways of God's Son are the hope of the future. In obedience to our Lord, great power handles fairly, for the benefit of all. We are due a technology dividend in Christian nations. Easier living, more peaceful ways, great richness at less expense, and freedom from want at a global scope are in the power of Christ to give. May the Christian Commentary decorating the 2006 thesis edition inspire hope for a better world, especially among those of the high tech community invested with power to bring new and wonderful things to life. It also is hoped that the completely educated man, as the world's terminal degree (doctoral of philosophy) purports to crown, eventually will be required to center qualifying work in the timeless truth of God. To understand the world without taking into account its Creator is incomplete understanding. In these days of immense knowledge power, one is further instructed to limit higher education to those who first qualify by a right relationship with God, in whose Kingdom we live. Without divine light, scholarly power is squandered and misdirected. Forbid that the fraternity of wise and educated men becomes destroyers of so majestic a handiwork as our Earth and Great Society compose. Psalm 19 aptly closes the Foreword dedication in admiration of the glory of God. He is the true potentate and source of all knowledge and life:

*The **heavens declare the glory of God**; and the **firmament showeth his handiwork**. Day unto day uttereth speech, and night unto night showeth knowledge. There is no speech nor language, where their voice is not heard. Their line is gone out through all the earth, and their words to the end of the world. In them hath he set a tabernacle for the sun, Which is as a bridegroom coming out of his chamber, and rejoiceth as a strong man to run a race. His going forth is from the end of the heaven, and his circuit unto the ends of it: and there is nothing hid from the heat thereof. The **law of the LORD is perfect**, converting the soul: the **testimony of the LORD is sure**, making wise the simple. The **statutes of the LORD are right**, rejoicing the heart: the **commandment of the LORD is pure**, enlightening the eyes. The **fear of the LORD is clean**, enduring for ever: the **judgments of the LORD are true and righteous** altogether. **More to be desired are they than gold**, yea, than much fine gold: **sweeter also than honey and the honeycomb**. Moreover by them is thy servant warned: and in keeping of them there is great reward. Who can understand his errors? **cleanse thou me from secret faults**. **Keep back thy servant also from presumptuous sins**; let them not have dominion over me: then shall I be upright, and I shall be innocent from the great transgression. **Let the words of my mouth, and the meditation of my heart, be acceptable in thy sight, O LORD, my strength, and my redeemer**. Psalm:19*

To the Praise of His Glory

William C. Patterson
Pittsburgh, Pennsylvania
2006

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Key Words in **Bold Print** are Original Terms Introduced by This Dissertation Research
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Chapter I
INTRODUCTION

This introductory chapter will describe the purpose for researching strategic planning and control systems in high technology firms. In specific terms, the research question that the study attempts to answer will be framed, and some of its ramifications will be discussed. The chapter concludes with a brief explanation of why research of this nature is significant to academics and practitioners who deal with the field of strategic management.

A. PURPOSE OF THE RESEARCH

Maturing markets, lagging labor productivity, and declining international competitiveness in America's basic industries have focused attentions on **high technology business** as a partial cure for the nation's economic ills (Krishna and Rao, 1986). Attesting to the historical potential of high technology industries was an **output growth rate double that of all U.S. industry**, **labor productivity six times the national norm**, **price inflation 1/3 the national rate**, and **sizeable trade surpluses** during the 1970-1980 period. (U.S. Department of Commerce, 1983). As more developed nations turn to high technology as a basis for their export trade, competition in this arena is escalating. The U.S. leadership position is being severely challenged, and trade balances are shifting to deficit (Hatter, 1985; Finan and Sandberg, 1986). In 1989, for the first time in history, a negative balance was recorded in U.S. computing equipment trade, an area of high technology activity with a strong tradition of U.S. dominance (U.S. Department of Commerce, 1992).

High technology enterprise is on the cutting edge of technology and, in some respects, on the cutting edge of strategic management. Few businesses operate in an environment that is changing at such a rapid pace. For example, **product life cycles of less than five years** are common. In addition, competition occurs within a technological context of increasing sophistication among firms with diverse strategies, making the environment one of high complexity. The combining of these two factors, the fluid nature of product innovation and veil of sophisticated technology that enshrouds product/market factors, makes the **high technology environment extremely difficult to accurately comprehend**. Contemporaneous existence of such **dynamism**, **complexity**, and **uncertainty** characterizes the environment as "**multidimensional**" and creates significant management challenges.[1]

[1] The terminology "**multidimensional environment**" is meant to indicate an environment that simultaneously exhibits high levels of several attributes, such as uncertainty, volatility, dynamism, instability, turbulence, complexity, heterogeneity, dispersion, scarcity, etc. (Dess and Beard, 1984; Snyder and Glueck, 1982). It stands in contrast to a **unidimensional** or **linear environment** which exhibits an appreciable level of only one such attribute.

Some who direct high technology businesses hold that **strategic planning is not workable** in their context (Patz, 1981). They argue that it **hinders flexibility and creativity** in the process of trying to impose order and predictability. Schoonhoven (1984) challenges this indictment with evidence of focused strategic behavior among better performers in the semiconductor industry.

A synthesis for these opposing views may exist. Possibly, **systems for strategic planning and control being employed by the mainstream of American business are not directly translatable to high technology enterprises**. Strategy itself still may be valuable, but the mechanism by which it develops might require alteration from the more traditional prescriptions. The central objective of this dissertation is to **identity appropriate configurations and/or attributes of strategic planning and control systems for high technology firms** through a careful examination of the strategy literature and empirical testing of findings in selected high technology industries.

B. RESEARCH QUESTION

The central question, which serves as both a theoretical and practical focus of this research effort regarding strategic management of high technology firms, may be stated as follows:

> *How should the process of strategic planning and control be configured to function effectively in a high technology firm?*

If the process of strategic planning being practiced in conventional businesses is regarded as problematic by managers of high technology companies, then **the parameters of workable planning processes need to be established**. The fluid nature of management in high technology enterprises suggests that control is problematic as well. Multidimensional environments foster shifting strategies that would tax the response capabilities of control systems found in most organizations. However, the remarkable performance record of high technology enterprises strongly suggests that control has not been a casualty. It is, therefore, an engaging research challenge to **ascertain also the characteristics of those strategic control systems capable of functioning effectively in a high technology environment.**

Other issues subsumed under this research question will be addressed in a complementary fashion. First, it would be naïve to expect one, single system configuration for strategic planning and control to be employed by all high technology firms. It is likely that there are many variations which serve their users adequately. This study attempts to **uncover some of the more prominent variants.**

If there are diverse approaches to strategic planning and control among high technology firms, another obvious concern is **which approach gives the best results**. Since some system configurations may be inappropriate in certain contexts, appraising the performance attributes of several viable forms also is a useful result.

Other intriguing issues that surface in connection with this research question relate to technology strategy content. This becomes relevant because **there is not yet a consensus regarding the definition of high technology enterprise**. A burden assumed by this research is to **establish validity of the context examined**. This will be attempted by **evaluating the salience of technology strategy content factors in achieving success** among the firms studied.

Synthesis of process and content also is explored within the scope of this research question. **Effective processes for strategic planning and control in high technology firms should yield effective technology strategy content**. A search will be conducted for the evidence of this complementarity.

C. SIGNIFICANCE OF THE STUDY

High technology firms have been increasing in number and importance in the American economy. They exhibit characteristics of performance that give them high visibility domestically and internationally. Domestically, these businesses have come to be regarded as the **cornerstone for a prosperous economic future**. Internationally, they represent one of the **most potent forces this country can commit to the global marketplace**.

With a few notable exceptions, **much of the knowledge generated by strategy researchers has been extracted from studies of traditional industries**. Resulting theories are not readily generalizable to the high technology context. The **unique demands placed upon strategic planning systems in high technology firms invites research** that addresses these needs directly, rather than through analogy.

This study is intended to contribute to the small but growing body of research knowledge specific to the important domain of high technology. It offers a conspicuous opportunity to advance knowledge about the impact of technology on strategic planning and control systems. Managers of high technology firms should benefit from this kind of research to the extent that it can **reduce** their **need for risky experimentation** by furnishing them with some empirically-based research results.

To the degree that traditional business environments are becoming multidimensional, this **research also should give mainstream strategy researchers and practitioners some indication of what they might expect in the future**. In this connection, the high

technology firm may serve as a "bellwether" for strategic management theory and practice.

The next chapter lays the groundwork for studying strategic planning and control systems in high technology firms by exploring some highly relevant literature from the strategy field. This is a prudent first step because such research helps to establish a theoretical framework for interpreting the basic needs and uniqueness of this challenging business domain.

Chapter II
LITERATURE REVIEW

This chapter explores three research streams which are critical to understanding issues involved in trying to plan and control from a strategic perspective in high technology firms. Literature dealing with formal strategic planning systems, strategic control systems, and technology strategy is reviewed. Even though research specifically targeted for high technology environments represents a relatively small portion of all researched knowledge in these areas, this body of literature is a fertile resource for theory building.

Augmenting exploration of these distinctively academic research bases is a survey of literature drawn from sources possessing a strong practitioner orientation. While sometimes less structured or integrated than its academic counterpart, the executive perspective it portrays nonetheless provides valuable insights and current raw material for the overall literature synthesis with which the chapter concludes.

A. FORMAL STRATEGIC PLANNING SYSTEMS RESEARCH

Academic research on formal strategic planning systems has been epochal. The earliest work appeared during the 1960s. Learned, Christensen, Andrews, and Guth (1965) provided some of the initial conceptual framework for strategic planning and pioneered the systematic treatment of general management problems. Ansoff (1965) and others also contributed significantly to conceptual development of the field.

Results from descriptive field studies of planning in 45 large corporations were published by Henry in the mid-1960s (Henry, 1967). Interviews with planners and executives revealed the existence of simple, formal, numerically-intensive procedures with little strategic analysis or strategy formulation. Seminal research by Aguilar (1967) drew attention to the emerging importance of environmental scanning to top management planning and identified some of the more effective approaches to collecting external information. Also in this timeframe, Steiner (1969) published a book detailing the past, present, and future of "comprehensive corporate planning" which had significant influence on early development of the field.

Perspective Alpha: Strategic planning is management's newest dimension. It responds to the need of global reach across time to master the management process and establish functionality within a context changing at the speed of light via computing and communications technology. Cumulative knowledge, competent research updating, and instantaneous interfacing of workforce and environment via electronics seem requisite to the strategic management challenge. However, with solutions outpaced by a frenetic rate of problem generation during the **strategy era**, a further dimension of management needs to open: the **Corporate Christ** dimension.

William C. Patterson Ph.D.

Perspective Alpha.WMA

Research intensified significantly during the 1970s. The focus primarily turned to identifying the financial performance implications of strategic planning. Thune and House (1970) found that formal planners outperformed informal planners in the drug, chemical, and machinery industries. In this study, planning was deemed formal if strategy and goals were projected at least three years into the future and if actions plans, projects, and procedures were developed to accomplish goals. Ansoff et al. (1970) found that firms which planned more comprehensively for acquisitions fared better than non-planners. Here, comprehensiveness was indicated by the existence of explicit corporate objectives and strategies for acquisition, formal search procedures, standards of candidate evaluation, and definitive budget support. Herold's (1974) work extended the Thune and House (1970) study with confirmatory results. Karger and Malik (1975) analyzed the planning practices of companies in the chemical, drug and cosmetic, electronics, and machinery industries. Firms which covered the entire organization, each division, and each plant for one-year (operational plan) to five-year (strategic plan) periods were classified as formal integrated long range planners. They consistently outperformed their non-planning counterparts. Other studies tending to reinforce the emerging hypothesis that formality and comprehensiveness in planning benefit financial performance include Rue and Fulmer (1973), Burt (1978), and Wood and LaForge (1979). Conceptual evolution of the field also continued during this timeframe through synthesizing efforts of Camillus (1972), Lorange and Vancil (1977), and other scholars.

There were studies in this timeframe that failed to offer confirming evidence of a positive relationship between planning and performance (Grinyer and Norburn, 1974; Kudla, 1980; Leontiades and Tezel, 1980). However, these findings do not appear to have seriously challenged the acceptance of planning formality and comprehensiveness as performance benefactors. The main impact of the non-confirming studies appears to have been in the area of research methodology. Adoption of more sophisticated means and ends led to a research agenda for the 1980s with much greater conceptual diversity.

Robinson and Pearce (1983) and Robinson (1982) postulated firm size as a contingency variable and turned the focus of research from primarily large firms to the smaller firm. Planning in the latter was found more effective with the introduction of outsiders to the process, and with a low level of formality (indicated by the amount of written documentation).

The environment emerged as another significant contingency variable. Fredrickson and Mitchell (1984) found evidence in the volatile sawmill and planing industry that the synoptic decision processes entailed in comprehensive planning were dysfunctional in unstable environments. They were effective, however, in the stable environment of the paint and coatings industry (Fredrickson, 1983).

King (1983) called for a paradigmatic shift in planning system research that has taken hold to some degree. Prior effort, which focused on the planning system-financial performance relationship, tended to regard the planning system as a "black box." A direct methodology, which assesses details of the process (inputs, goals, outputs, etc.) and emerging functional standards, was recommended.

Ramanujam et al. (1986) employed direct methodology in their multidimensional, multi-objective study of planning systems in over 200 firms from the Fortune 500 manufacturing and services listings. Effectiveness was measured in terms of objective fulfillment (in 6 categories), relative firms performance (in 5 categories), and satisfaction with the planning system. The dimensions assessed were, in descending order of importance, (1) planning system capability, (2) organizational resistance to planning, (3) resources provided for planning, (4) functional area coverage, (5) use of techniques, (6) attention to external facets, and (7) attention to internal facets.

In a follow-on study, Venkatraman and Ramanujam (1987) examined the interplay and validity of objective fulfillment variables and planning system capability variables as co-determinants of planning system success. Since capabilities were strong predictors of objective fulfillment variables, the former were not ruled out as the primary, relevant success criteria. The 12 capability indicators in order of decreasing explanatory power were (1) ability to foster learning, (2) ability to enhance the generation of new ideas, (3) ability to foster managerial motivation, (4) ability to integrate diverse functions and operations, (5) ability to communicate top management's expectation down the line, (6) ability to identify key problem areas, (7) ability to enhance motivation, (8) ability to communicate line managers' concerns to top management, (9) ability to foster management control, (10) ability to identify new business opportunities, (11) ability to anticipate surprises and crises, and (12) flexibility to adapt to unanticipated changes.

Chakravarthy (1987) conducted a multi-industry survey of senior executives to ascertain the degree to which strategic planning systems are tailored to their environments. Four strategic planning system types were proposed on the basis of goal-setting direction, budgetary tightness, planner role, frequency of plan review, nature of control, and incentive criteria. Contextual variables included portfolio pressure, financial pressure, and cultural setting. Hypothesized relationships between context and planning system types were not found. Neither did managerial ratings of planning system effectiveness correlate with company financial performance. These negative results highlight the difficulty of finer-grained research on environment-firm alignment, and reveal possible antimony between direct and indirect methodology.

A descriptive, longitudinal study of two high technology firms from Silicon Valley by Bahrami and Evans (1989) produced some process clarification for strategic planning in that context. Grounded theorizing suggested that planning proceeds under the umbrella of an abiding entrepreneurial vision with early experimentation to test market and product

congruence. This empirical process eventually leads to a concrete strategy and subsequent escalated commitment of resources. This description appears to be a blend of entrepreneurial and planned strategy formation processes, as observed and described by Mintzberg and Waters (1985). Their entrepreneurial model is distinguished by a strong, individual leader who imposes his vision on the organization in a deliberate, but adaptive way. Eventually, this mode of strategizing evolves into a more formalized (planned strategy) exercise where top management formulates its intentions more precisely in a written plan and arranges for collective action through coordinated implementation processes, such as budgeting and scheduling.

It is too early to discern the orientation of research on strategic planning systems for the 1990s. A review of 28 studies by Armstrong (1991) reaffirms the value of formality in planning, especially for manufacturing firms. Camillus and Datta (1991) propose revisions to conventional planning models involving continuous scanning and issues management to make them more responsive to environmental turbulence. Conceptual refinement of concept and process also continues (Hax and Majluf, 1990). Perhaps these initial offerings herald attempts to design a more sophisticated and robust mainstream model that will accommodate the frequent increases in environmental volatility that are occurring.

Although this review is not meant to be exhaustive, it is adequate enough to permit some legitimate observations about the state of formal strategic planning and to suggest prescriptions for planning in high technology settings. Three themes appear to dominate the literature. First, the conceptual underpinnings of strategic planning appear to be shifting from the rational model to one predicated on bounded rationality. This is being driven by changes in the environment, and is legitimizing increased experimentation in strategic choice processes. Second, there is an unmistakable shift in the evaluative basis for strategic planning systems. Externally-linked, objective criteria focusing on outputs are giving way to internal, subjective criteria focusing on process functionality. Apparently there is widening recognition that the bottom-line responsibility traditionally assign to strategic planning does not necessarily insure that the host of other performance moderators are or can be perfectly synchronized with strategy in real time, and that performance criteria based upon user perceptions best deal with present fuzziness in this complicated cause-effect system. Finally, the conventions of process specification are changing. Linear models are being replaced by contingency models that better align organizations with increasingly diverse and problematic business environments.

Given the broad validity of the aforementioned trends, research on strategic planning systems for high technology firms should attempt to be responsive to each of them.

B. STRATEGIC CONTROL SYSTEMS RESEARCH

Perspective Beta: The synoptic review of the strategic control literature is more than 50% longer than the strategic planning review. This volume difference signifies larger emphasis being given control in the management process. Amidst a management context of growing dynamism, complexity, and uncertainty, management as planning has less tenability, management as control its insufficient surrogate. As the concept umbrella for strategic control enlarges, there is not so much a sense of requisite knowledge, as there is sense of elusiveness. Beckoned in the matter is the infinite Mind of Christ overarching management, planning, control, and managers. While the supernatural is an uncommon dimension for management research and understanding, it is the very domain of solution for the New Millennium of global industry, fully peaceful, fully providing. Latent in our strategic control dilemma is a wonderful welcome by God to be our masterful corporate head.

William C. Patterson, Ph.D.

Perspective Beta.WMA

*There hath no temptation (test) taken you but such as is common to man: but **God is faithful**, who **will not suffer you to be tempted (tried) above that ye are able**; but will with the temptation (challenge) also **make a way to escape (provide a solution)**, that ye may be able to bear (manage) it. 1 Corinthians:10.13*

The literature on strategic control is largely conceptual and has its roots in the more developed field of management control. Anthony (1965) proposed a framework that intimately links strategic planning and **management control**. He defined the latter as "the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives" (1965:27). According to his view, management control entails dimensions of both planning and control. The planning component is of the systematic and recurring type associated with the ongoing administration of the organization, and is distinguishable from broad, higher-level strategic planning. He believes planning and control are separable in concept, but not in practice. This is evident from a list of representative management control activities:

- Formulating budgets
- Planning staff levels
- Formulating personal practices
- Working capital planning
- Formulating advertising programs
- Deciding on research projects
- Choosing product improvements
- Deciding on plant rearrangement
- Deciding on routine capital expenditures
- Formulating decision rules for operational control
- Measuring, appraising, and improving management performance (Anthony, 1965:19)

Camillus (1986) amplifies Anthony's (1965) framework by observing that Anthony's concept of strategic planning really entails strategic control. First, strategic plans actually limit the range of choice for managerial decision making. Additionally, the planning process tends to enculturate those who participate in it. Also, the strategic plan coordinates key resource allocations via the capital budgeting subsystem it empowers. Lastly, responses to unanticipated changes tend to be handled by the strategic issues management subsystem, also imbedded in the strategic planning system.

Camillus (1986) offers a definition of **control** that is not level-specific:

> Control is a behavioral process that involves measurement and evaluation of the performance of organizational units, the identification of deviations from planned performance, the initiation of appropriate responses to these deviations, and the monitoring of remedial actions, all done with the intent of ensuring that managers' decisions and actions are consistent with planned organizational objectives (Camillus, 1986;11).

Schendel and Hofer (1979) offer one of the earliest conceptualizations of **strategic control**. They maintain that:

> The essence of strategic control is to insure that the strategy selected is in fact being used, and if used, that it is producing the performance results that it was intended to achieve. Strategic control differs from financial controls and the budgetary controls used in operating management in terms of the scope and time horizon it concerns. It is less interested in efficiency in an input/output sense than it is in assuring the proper direction and rate of progress of the organization toward its strategic goals and objectives (Schendel and Hofer, 1979:525).

Lorange et al. (1986) focus specially on strategic control systems. According to their conceptual framework, a strategic control system is "a system to support managers in assessing the relevance of the organization's strategy to its progress in the accomplishment of its goals, and when discrepancies exist, to support areas needing attention" (Lorange et al.,1986:10). Two purposes of strategic control are described. Controlling **strategic momentum** involves maintaining strategic direction in the face of environmental adversity. The key is ascertaining whether or not assumptions upon which the strategy is based continue to be valid despite changing circumstances. Strategic momentum control can be accomplished through the use of traditional responsibility centers, assumption control, and checks against generic strategy prescriptions (such as those offered by the Profit Impact of Marketing Strategy database). Controlling **strategic**

leaps involves radically reformulating strategy when discontinuities in the environment reach a magnitude sufficient to substantially undermine the existing strategy and invalidate key assumptions. **Strategic leap control** calls for a major shift in the reference frame that can be facilitated by strategic issues management, value chain analysis, computer modeling, and alternate scenario planning.

Schreyogg and Steinmann (1987) eschew the view of strategic control as a feedback process. They contend that feedback information arrives too late to affect strategy, and standards of performance might be presumed correct when, in fact, they are deeply flawed. Furthermore, the ambiguous context within which strategic planning takes place necessitates considerable information selection to yield an actionable result. They propose use of **feedforward control** within the context of a three-part strategic control model to remedy the problems with feedback control, ambiguity, and selection. **Premise control** is put forth as a means to continuously evaluate validity of premises for strategic planning and implementation. **Strategic surveillance** entails unfocused monitoring of internal and external events for threats to the strategy. Finally, **implementation control** involves assessing milestones for evidence that the strategy needs to change. This is not to be confused with judging whether or not implementation is progressing according to plan, their view of **operational control**. In general, they portray strategic control as continuous probing without a high degree of formality and centralization to challenge validity of the current strategy. It reflects a readiness of the organization to learn as well as unlearn (Fiol and Lyles, 1985).

A study by Veliyath (1992) further amplifies **feedforward/feedback** issues. Based upon a classificatory survey completed by strategic management faculty and middle managers, he found that hindsight activities have an efficiency orientation, well-suited to stable business environments. Anticipatory or feedforward activities, on the other hand, promote effectiveness in turbulent environments. Properly balancing these two control modes within a given environmental context should optimally blend short-term and long-term performance.

Hoskisson and Hitt (1988) studied the effect of strategic control systems on the level of resource commitment to R&D in large, multiproduct firms. They found evidence that the short-term, risk-averse financial controls usually employed in diversified (M-form) organizations lead to lower levels of R&D intensity. Looser controls which exploit synergy are associated with centralized, functional (U-form) organizations which make higher R&D commitments and are rewarded more favorably in the capital markets.

Contingency theory research from the management control literature also is relevant to strategic control. Here, the environment, organization structure, and technology are recognized as important control contingencies (Amigoni, 1978; Waterhouse and Tiessen, 1978; Otley, 1980; and Evans et al. 1985). Certainly, these variables are highly relevant to strategic control in high technology firms where environments are of high dimension,

organizations range widely in size and complexity, and technological change is more rapid than the norm.

Amigoni (1978) prescribes distinctive features of management control systems for turbulent environments. They should be future-oriented and highly responsive. If organizational complexity is high also, formality and procedural rigidity should moderate and the style of control should be relatively loose. Waterhouse and Tiessen (1978;70-71) recommend adjusting to environmental and technological uncertainty by focusing "on planning and internal resource allocation, on monitoring outputs which result from organizational members' actions, and on the selection, socialization, and professionalization of organization members." The latter is particularly important in settings where output might not be readily measured. Ouchi (1979) elaborates on the issues of selection, socialization, and tradition when measurability and the process by which success is achieved are not well defined. He contends that many organizations operate in just such ambiguity and uncertainty with loosely-coupled organizational units that frustrate bureaucratic control processes. This lack of organizational rationality is best dealt with by clan control mechanisms: informal evaluation on the basis of values, attitudes, and beliefs. This is the arena of corporate culture that researchers like Kilmann et al. (1985) claim must be managed for **adaptivity** if firms in volatile environments are to succeed long term. In an even broader context, Birnberg and Snodgrass (1988) found that national cultures emphasizing cooperation to be particularly beneficial to cross-functional communication and data flow in organizations. A caveat attaching to culture-based control systems is raised by Birnberg et al. (1983). They caution that when the environment is not conducive to formal control mechanisms, opportunity for dysfunctional behavior via self-serving distortion of organizational information systems increases.

Some management control researchers counsel that uncertainty demands a management control system that fosters organizational learning. Burchell et al. (1980) contends that accounting systems assume a multiplicity of roles to adequately deal with uncertainty. One mode is that of a "**learning machine**" which provides assistance rather than answers (Burchell et al., 1980:15). In information systems parlance, this is regarded as a decision support system (Gorry and Scott Morton, 1971). Argyris (1977:113) explains that an organization learns "to the extent that it identifies and corrects errors." Single-loop and double-loop learning are distinguished. When behavior remains consistent with norms and policies, **single-loop learning** is portrayed. However, when norms, policies, and directives that are supposed to guide behavior become subject to revision themselves, **double-loop learning** is enabled. Hedberg and Jonsson (1978) criticize contemporary control systems for fostering stability to the exclusion of double-loop learning. They call for destabilizing control systems which not only alert to problems, but also heighten curiosity, deal with variety, and activate dialectical decision processes. Landau and Stout (1979) make the broadest case for learning facilitation in control systems by declaring that management is intrinsically experimental. Accordingly, errors frequently are the

result of executing faulty directives (which they label type II errors). They recommend a pragmatic approach to management laden with sufficient ambiguity to establish a "**zone of acceptance**" rather than to strive for a precise but unrealistic optimum solution (Landau and Stout, 1979:151).

Huber (1991) provides a classificatory review of key organizational learning concepts and literature that anchors the previous discussion in the broader context of classical organizational learning literature. High technology firms fit within his schema as "**experimenting organizations**" that acquire knowledge through experimental means primarily. They excel at adaptability, rather than simple adaptation, to achieve long-term survival. Their readiness to embrace change on a continual basis emerges as an essential skill for functioning in dynamic, unpredictable environments.

The broadening usefulness of organizational learning skills has been reported by Senge (1990), who observes that leading corporations increasingly practice "**generative learning**" to be creative. The total quality movement is given as an example of this type of double-loop learning. Building a "**learning organization**" is regarded by Senge as an emerging management responsibility expected to demand new leadership rules and skills.

Innovations in operations management over the past decade or more have motivated new thinking in management control theory and practice that has implications at all organizational levels. Factory automation and computer integrated manufacturing progress brought about by computer aided design/computer aided manufacturing, flexible manufacturing systems, and office automation, as well a progress associated with total quality management and just-in-time inventory systems, are sorely taxing control processes rooted in standard costing and financially-based performance measurement (Kaplan, 1984 and 1990; Lessner, 1989). Revamped, highly-integrated control systems relying heavily upon direct, nonfinancial performance measures for tracking quality, delivery, productivity, innovation, inventories, and workforce attributes are emerging as viable solutions.

Control as a general management topic has been explored by Green and Welsh (1988). They conceptualize control as **cybernetic regulation** "that directs or constrains iterative activity to some standard or purpose" (Green and Welsh, 1988:291). Dechert (1966) and Hofstede (1978) helped to mold their interpretation of cybernetic regulation, regarded as the foundation of control in any control system:

> By *cybernetic* we mean a process in which a feedback loop is represented by using standards of performance, measuring system performance, comparing that performance to standards, feeding back information about unwanted variances in the system, and modifying the system's comportment (Green and Welsh, 1988:289).

Unique to their perspective is the issue of resource dependency. An organization can be perceived as depending on subunits to provide the resources it needs and investing in control systems to see that critical resources amenable to control are provided to it with appropriate characteristics of quantity, quality, and timeliness. Addressing resource flows focuses on output rather than behavior measurement, thereby fostering subunit autonomy regarding production means. Meta-control systems that link networks of local cybernetic systems with in an organization are mentioned by the authors. These might be construed as strategic control systems. Research by Sands (1987) reinforces the value of **flexible implementation** for control systems functioning in uncertain environments, but cautions that priorities given activities (means of objective accomplishment) should be congruent with priorities given to high-level objectives.

Agency theory has been used to study management control problems by examining the nature of contractual relationships between principals and agents presumed to be motivated by self interest (Baiman, 1982). Agency research on participative control systems has relevance to high technology settings, where considerable private information of a technological nature is held by agents (Baiman and Evans, 1983). Conventional two-person agency models taking into account the sharing of private pre-decision and post-decision agent information with the principal (management) have been evaluated Pareto superior (i.e., the welfare of some improves without reducing the welfare of any) to models without such information sharing. This provides some support for maintaining openness in decision-making processes for high technology organizations.

Along the stream of research just reviewed there has been considerable clarification and elaboration of the control concept as applied to business organizations. Starting from a perspective that ambiguously linked planning with control, researchers now are better able to isolate the concept for analysis and more focused development. Distinctions between feedforward and feedback modalities exemplify the kind of conceptual enrichment that has occurred. A rapidly unfolding agenda of contingency research is helping organizations cope with environmental volatility, complexity, uncertainty, etc. This branch of study has considerable relevance to high technology firms. It points to the utility of learning processes, integrative control schemes, output control, and corporate cultures in this venue.

C. TECHNOLOGY-RELATED STRATEGY RESEARCH

Literature focusing on the strategic implications of technology is appearing with increasing frequency in the strategy field. Much of it is conceptual, but empirical content is growing. Although specific attention to strategic planning and control systems is rare, many prescriptions for such systems can be diffusely drawn from this domain.

Five significant attributes of strategic planning and control systems emerge from this literature base that are relevant to high technology firms. Collectively they reflect the distinctive character of planning and control in a technological context *vis a vis* the mainstream of business activity. In approximate order of emphasis, they are: integrative capability, risk accommodation, technical knowledge focus, organizational learning facilitation, and vision projection.

1. Integrative Capability

Perspective Gamma: Bringing oneness out of fast-paced, sophisticated diversity is the salient management challenge in high technology firms and industries. How can a business converge to a decision or plan when minds are differently educated, character is differently composed, purposes interpret differently, jobs are vastly different and specialized, and products are *black boxes* no single person fully understands? God promises to make all things beautiful in their own time (Ecclesiastes:3.1-11), and these are times compelling us toward the Great Unifier: God's Holy Spirit. He has power to bridge from what we know to what He knows, and make it all work out beautifully. We dare not abdicate human responsibility in the pressing world of high-tech decision-making, but we also dare not proceed without divine decision insurance of the Spirit. Consider the following several integrations researchers have discovered as important in strategic planning and control systems in the context of invitation to put more responsibility on God, to collaborate in Christ, and trust His administration to work things together for good effect.

William C. Patterson Ph.D.

Perspective Gamma.WMA

*Now there are **diversities** of gifts, but the same Spirit. And there are **differences of administrations**, but the same Lord. And there are **diversities of operations**, but it is the **same God which worketh all in all**. But the manifestation of the **Spirit is given to every man to profit** withal. 1 Corinthians:12.4-7*

Strategic planning and control systems in technologically-intensive settings are called upon to effectively integrate diverse entities. As the most general level, provision should be made for the firm to interact with the environment in order to identify promising opportunities and problem solutions (McGinnis and Acklesberg, 1983). Porter (1985) calls for the scope of technologies considered in a firm's technological strategy to include suppliers and customers so that developments surfacing from the extended value chain may be intelligently considered in the firm's pursuit of competitive advantage. Ettlie (1988) also affirms the need to integrate the firm with suppliers and customers to fully exploit the potential of computer integrated manufacturing. Hayes and Jaikumar (1988) echo the same message for the purpose of reaping the benefits from all forms of programmable automation. Chase and Erikson (1988) predict that the factory of the future will have a strong service orientation which involves the customer more intimately with manufacturing operations than ever before.

Intrafirm integration activity and skill also appear to be important. Souder (1987) studied 289 product innovations over a ten-year period and found that eliminating disharmony between marketing and R&D groups was a significant factor in determining innovation success. Reukert and Walker (1987) underscore the sensitivity of this issue in their study

of conflict in three strategically different business units. Here, conflict between marketing and R&D arose most frequently in the most innovative unit. Integration of design engineering with manufacturing and business systems with the shop floor will be among the radical administrative changes needed to successfully employ the latest manufacturing technologies, according to Ettlie (1988). A study of organization designs by Souder (1983) showed that those fostering integration best facilitate innovation processes.

Integration also emerges as a priority within the planning and control system itself. Fusefield and Spital (1980) observe that futures research needs to be formally integrated with long range planning if the full benefit of technology forecasting is to accrue to the planning process. In a study of nine companies with varying commitments to technology, Frohman (1982) found that those who relied on technology for competitive advantage carefully integrated business goals and made technical planning an integral part of the strategic planning process. Similarly, White and Graham (1978) present evidence that innovation success requires a careful blend of both technical and business concerns. Finally, Skinner (1984) claims that competitive advantage via equipment and process technology will be elusive until operating management is more full integrated into the strategic planning process.

Diverse means are portrayed in the literature for satisfying integration needs in a technological context. Ad hoc groups possessing specialized expertise in the domains requiring integration are widely used and recommended. Formally, these carry familiar descriptors like teams, task forces, and project groups. (McGinnis and Acklesberg, 1983; Souder, 1987) Integration is similarly accomplished through an active schedule of information-sharing meetings among diverse parties and by informal discussion (Camillus, 1984; Sherman, 1984). Eschenbach and Geistauts (1987) suggest incorporating technologists in the strategy formulation process. The whole process of integration (by any means) is made easier by reducing the level of formalism in organizational systems (McGinnis and Ackelsberg, 1983).

Technology portfolios have been proposed as one way to integrate business and technology concerns. Petrov (1982) describes a technology attractiveness/relative technological position matrix and Sethi et al. (1985) describe a similar technology importance/relative technology position matrix. These complement rather than supplant traditional matrix formulations. Quinn (1985) calls for more complex portfolio planning to better address innovation needs.

The connection between business strategy and technology strategy is made by Frohman (1985) through the inclusion of **distinct technological competencies** (DTCs) and **strategic technical areas** (STAs) in the planning process. The latter derive from users and reveal the technologies they demand now and into the future. DTCs represent what

the firm is technically adept at doing. All DTCs are candidates for commercial exploitation, and STAs form the blueprint for developing DTCs.

2. Risk Accommodation

Perspective Delta: Innovation is fueled by individual creativity, inventivity, and vision. Yet collaboration via organizations is needed to implement ideas. Organizations that civilize the environment for creatives, or promote them by privilege, do best. Amidst the immense power of big corporations, lessons about individual power, origination power, seem to get lost. Some have seen the 20th Century as the age of politics and group behavior. Spiritual eyes see it as a time consummating in the individual power of Christ, the God-man. In Christ we can do all things. By individuals (prophets, priests, His Son, and Apostles) has God's agenda for man been succeeding across millennia. Likewise is the prepared man of Christ focal for success in high technology. Only he will be able to wield the vast power of high tech blamelessly, without power abuse. Only he has God's amazing promise of faultless success. Find these men, and risk is fully accommodated. Whatever they do prospers!

William C. Patterson Ph.D.

Perspective Delta.WMA

*Blessed is the man that walketh not in the counsel of the ungodly, nor standeth in the way of sinners, nor sitteth in the seat of the scornful. But his delight is in the law of the LORD; and in his law doth he meditate day and night. And he shall be like a tree planted by the rivers of water, that bringeth forth his fruit in his season; his leaf also shall not wither; and **whatsoever he doeth shall prosper**. The ungodly are not so: but are like the chaff which the wind driveth away. Psalm:1.1-4*

Firms operating in technologically active settings appear to handle risk in distinctive ways. Much is done on an individual basis. Maidique (1980), Kantrow (1980), Meredith (1986) and Souder (1987) are among those who find **product champions, process champions, entrepreneurs,** and **intrepreneurs** to be key players in planning and control. The former two distinguish themselves by taking extraordinary risks to champion a technology in which they believe. The latter two assume high risk relative to commercialization of products or services. These roles are so vital to pushing back the frontier of uncertainty that project support often depends on the individual more than the objective merits of the project.

The management control system plays a key role by rewarding risk-takers with diverse incentives that have a long-term rather than short-term output focus (Camillus, 1984; Sherman, 1984; Skinner, 1984; Mendell and Ennis, 1985; Quinn, 1985). Accompanying this positive reinforcement is organizationally-provided protection from down-side risk. Sherman (1984) found that successful innovators insulate their risk-takers from financial adversity and generally avoid punishing failures, a posture also noted by Maidique and Hayes (1984). Readiness to punish is linked by Hayes and Abernathy (1980) to declining innovation and competitiveness in American business. In larger companies there is a beneficial tendency to diffuse risk by spreading it among many bearers, including the CEO (Sherman, 1984).

The high risk of developing new technology is accommodated through what appears to be a rather effective combination of policies. A healthy degree of experimentation is afforded by supporting a broad risk spectrum among R&D projects and making the funding for new projects relatively easy to obtain from a variety of sources (Sherman, 1982; Maidique and Hayes, 1984; Quinn, 1985). Probability of failure is cut by supporting multiple parallel technology approaches (Quinn, 1985). However, when projects develop to the point of requiring significant resource allocations, they are exposed to rigorous internal testing before further funding is provided (Sherman, 1984 and Quinn, 1985).

3. Technical Knowledge Focus

Perspective Epsilon: High technology takes society into esoteric knowledge. Few understand the key things deeply. Higher education is essential . . . even to doctor of philosophy. God is the source of all knowledge, and He has been giving liberally for thousands of years. There is much to master. But He desires that we do that homework before He adds to it. Respect what has already been given, not asking for another revelation of it, and then seek what is new, original. Highly educated technologists do best in strategic planning and control because they have registered with history. They understand the past lessons. To them is divine creativity showered. They discover. They invent. They envision. These heads commune with God, and yield the foretaste of heaven on earth. Delightful things decorate our world because beautifully educated minds are favored by God to add to our days, give ease to our lives.

William C. Patterson Ph.D.

Perspective Epsilon.WMA

*Therefore shall **ye lay up these my words** **in your heart and in your soul**, and bind them for a sign upon your hand, that they may be as frontlets between your eyes. And ye shall teach them your children, speaking of them when thou sittest in thine house, and when thou walkest by the way, when thou liest down, and when thou risest up. And thou shalt write them upon the door posts of thine house, and upon thy gates: That your days may be multiplied, and the days of your children, in the land which the LORD sware unto your fathers to give them, as the **days of heaven upon the earth**. Deuteronomy:11.18-21*

Technology-based firms place a premium upon technical knowledge that is uniquely reflected in their systems for planning and control. The most visible characteristic is that the strategy makers (CEO and top management in general) have a technical background which helps them to analyze the environment, accurately assess their firm's technology, and manage with a "hands-on" style (Sherman, 1984; Frohman, 1982; Abernathy et. al., 1983; Maidique and Hayes, 1984; Foster, 1986, Skinner, 1984).

When the firm as a whole is well-endowed technically, its innovativeness is enhanced. Organizations possessing greater complexity and depth in technological expertise posted better records for both radical and incremental innovation in a study of 40 domestic footwear manufacturers conducted by Dewar and Dutton (1986). Here, the innovations had to do with modern production technology.

Innovators always are learning more about the technologies with which they compete. Some firms ensure that their technologists interact closely with customers as a means to

generate new ideas while solving customer problems (Frohman, 1982). Others tap important technology sources through diverse relationships, such as joint ventures, consortia, limited partnerships, academic funding, etc. (Quinn, 1985).

Creative technologists are valuable assets in technology-based businesses (McGinnis and Ackelsberg, 1983). Accordingly, successful firms make an effort to accommodate creatives and establish an atmosphere where they can flourish (Souder, 1987; Quinn, 1985; Mendell and Ennis, 1985). This can mean tolerating unusual employees, nurturing openness and trust, looking out for employees' welfare, fostering free communication, stimulating cooperation, and encouraging participative decision making (Quinn, 1985 and Souder, 1987).

4. Organizational Learning Facilitation

Perspective Zeta: Wise men are able to establish products of permanence from organizations of stability owing to great foresight and understanding. The high technology environment is far from a "wise man" tradition. It is as though the wise mount a treadmill of information flow that discounts their wisdom and recasts them as children having to learn all over again. Leaving the issue of *foresight* to the next section, it is possible here to make the observation that high tech simply is moving too fast. Its leaders and society labor at a dizzying pace, always anxious about problems outpacing solutions. **Pace Frustration** produces far worse than do-and-re-do decisions. It causes psychological breakdown: anxiety, depression, bi-polar syndrome. In the frenetic milieu, many managements begin cutting corners, fudging results, making excuses, politicking, lying, or even engaging crime. When things are too fast for our own good, they can beckon those who are not good into the picture (such as organized crime). High technology enterprise is Godspeed enterprise (speed of light). There is no place for crime in this sacred domain. It is a holy trust. It also beckons the prudent to **slow down!** Profit-chasing with lightening-fast technology is not worth psycho-trauma, not worth criminalization. It is time for meekness (non-abuse of power), and letting the all-knowing Lord set the pace of life. High tech is herald to entering God's Rest: heaven on earth. That is the truth most worth learning for managing, planning, and controlling today.

William C. Patterson Ph.D.

Perspective Zeta.WMA

Hast thou not known? Hast thou not heard, that the everlasting God, the LORD, the Creator of the ends of the earth, fainteth not, neither is weary? There is no searching of his understanding. He giveth power to the faint; and to them that have no might he increaseth strength. Even the youths shall faint and be weary, and the young men shall utterly fall: But ***they that wait upon the LORD shall renew their strength****; they shall mount up with wings as eagles; they shall run, and not be weary; and they shall walk, and not faint. Isaiah:40:28-31*

The behavior of technology-based firms suggests that their strategic planning and control systems are configured to facilitate organizational learning in the sense used by Aryris and Schon (1978), Hedberg (1981), Fiol and Lyles (1985), and DeGeus (1988). These businesses must successfully navigate in multidimensional environments if they are to survive and prosper. A high rate of internal technology development also creates substantial impetus for change. Accordingly, the more successful firms exhibit a high degree of adaptability, flexibility, and responsiveness (McGinnis and Acklesberg, 1983;

Mendel and Ennis, 1985; Maidique and Hayes, 1984, Quinn, 1985; Schroeder and Hopley, 1988). In this context it is appropriate to note Hedberg's (1981) distinction between simple adaptation and learning. The former can be an uninformed reaction, while the latter implies behavior enlightened by understanding of causal relationships. **Adaptation** will be use in this study to signify informed adjustments by organizations, a usage consistent with Meyer (1982).

Frohman (1982) found that firms using technology as a competitive weapon have a particular sensitivity to emerging "windows" on technology and unfolding customer needs. Quinn (1985) also acknowledges a strong "need orientation" among successful small and large innovative enterprises. Strategic choice of a leadership or followership position with respect to technology also carries with it the responsibility to keep abreast of developments in the chosen technical domain (Porter, 1985 and Frohman, 1982). As technologies mature, firms need to be alert to the onset of discontinuities between old and new technologies if they are to manage this problematic transition successfully (Foster, 1986). The very demanding environmental context also places such a premium on fast, accurate learning that political behavior leads to performance concessions (Eisenhardt and Bourgeois, 1988).

Currently, organizational remedies mainly are invoked to facilitate learning. These remedies include keeping divisions small, keeping the organization flat, keeping formality to a minimum, and using "skunkworks" and technology incubators to emulate small company environments (Quinn, 1985; Souder, 1987; McGinnis and Acklesberg, 1983). Souder's (1987) finding that open, systematic decision-making processes benefit innovation also has prescriptive application here.

5. Vision Projection

Perspective Eta: *Vision* emerged only recently in strategic planning and control. Previously, *Mission* was consummate. Vision has spiritual significance. Prophets of old conveyed God's vision to man. Later, Jesus Christ, chief prophet and Son of God, made clear that He did only what His Heavenly Father **showed** Him *Jn:5.19-20*. Were God to move more directly into affairs of man in the Third Millennium, it would not be surprising to lead that move by surfacing terms and process connected to divine order. Where do visions come from? Have they a source you can identify precisely? Where do visionaries of high technology get their inspirational perspectives? Few say they are divinely led, yet lack an alternate accounting for source. That some corporate leaders crash pursuing great visions allows pragmatists to associate fallibility with envisioning. Biblical wisdom resolves this: Visions are essential to man: they are of God. Further, obedient servants of God, those lawful, those holy, are promised happy fulfillment. Tis Holy men of God who receive the best information, witness perfect visions, obtain and discharge effectual guidance. Expect such to emerge in this dawning age, bringing to high tech companies and society that elusive, stabilizing, certifying direction to which men will rally and success will crown.

William C. Patterson Ph.D.

Perspective Eta.WMA

*Where there is **no vision, the people perish**: but he that keepeth the law, happy is he. Proverbs:29.18*

Technology-based firms operate in a morass of complexity, dynamism, and uncertainty. Their survival does not appear to be formula driven. There is a common denominator to their management approach, however, that appears to figure prominently in their success: **vision**. Bahrami and Evans (1988) observed the existence of a context-defining vision which grounded all strategy-making in two Silicon Valley firms studied over a 2-1/2 year period. Quinn (1985) attributes innovative success in large companies to the presence and projection of a clear long-term vision that transcends simple financial goals. It helps to attract talented employees, focuses the firm's actions, and encourages investor support. He believes that **incrementalism** best serves the needs of **visionary management** (Quinn, 1980). This is because the innovation process is itself incremental. Since political and psychological support is allowed to develop as experimentation progresses, the chaos normally associated with this type of business can be effectively channeled.

From the standpoint of strategic planning and control systems, vision is fundamentally projected by a clear, widely-communicated mission statement (Sherman, 1984 and Camillus, 1988). In order not to frustrate the effect of superordinate goals, however, relatively ambiguous lower-level goals and process which create latitude for action are necessary (McGinnis and Ackelsberg, 1983). The highly experimental nature of the strategy-making process and the inherent risks of high technology enterprise led Souder (1987) to suggest exercising considerable patience in letting results occur and allowing the vision to be realized. Camillus (1988) proposes a formalized process for strategic vision generation that encompasses seven steps. These are: (1) issue generation, (2) issue prioritization, (3) issue clustering, (4) alternative generation, (5) determining dimensions of strategic choice, (6) identifying alternative strategic choices, and (7) formulating the vision statement. Dimensions of strategic choice figure prominently in the process. Each strategic issue has associated with it a continuum of options spanning the strategic choice space. The **strategic vision** is portrayed by the profile of desired positions on each issue-based continuum. Strategy formulation then becomes a matter of closing the gap between one's current profile and the envisioned profile. Adapting this scheme to high technology needs would appear to involve establishing a tentative, general **vision profile** initially, and then moving toward greater profile clarity as technology and other management uncertainties resolve.

D. STRATEGIC PLANNING AND CONTROL TRENDS IN TECHNOLOGY-ORIENTED FIRMS

High technology enterprise has been the focus of some of the most widely read books and periodicals. It frequently is offered as the model for good management practices, leadership, and innovation. While much of the evidence given is anecdotal in nature, some of the results are considered appropriate to report here to reflect practitioner views relative to strategic planning and control.

Perspective Theta: The firms of high technology bear witness to the erosion of formalism, rationality, reflection, and timeliness in management. Planning and control are bulwarks of intelligent directorship increasingly disintegrating under the hyper-pace and esoteric sophistication of this industrial theatre. Speed-of-light products and transactions shake the ship of industry so hard that it barely navigates, mostly reacts to the storms and rough seas in which it is cast. Jesus saved His discipleship when caught in a Galilee storm, quieting the waves, and chastising them for their little faith. To captains of high technology planning and control, He would likely say today: keep faith in God, slow the rate of progress to a humane level, manage your vessel reasonably (like you've been taught by timeless truth), and I'll keep the storms under control.

William C. Patterson Ph.D.

Perspective Theta.WMA

And, behold, there arose a great tempest in the sea, insomuch that the ship was covered with the waves: but he (Jesus) was asleep. And his disciples came to him, and awoke him, saying, ***Lord, save us: we perish****. And he saith unto them, Why are ye fearful, O* ***ye of little faith****? Then* ***he arose, and rebuked the winds and the sea****; and there was a great calm. But the men marvelled, saying, What manner of man is this, that even the winds and the sea obey him! Matthew:8.24-27*

One of the most popular management books in recent times is *In Search of Excellence* (Peters and Waterman, 1982). High technology firms constituted the largest segment of excellent companies comprising the research sample used by the authors. While the research methodology and premise of sample selection have been challenged (Carroll, 1983; Ramanujam and Venkatraman, 1988), the managerial prescriptions emerging from this study have considerable face validity and appear to have been widely embraced by corporate America. Principles having consequences for strategic planning and control include: (1) emphasizing action more than analysis, (2) maintaining close liaison with customers, (3) stimulating autonomy and entrepreneurial behavior within the organization, especially via small organizational units and limited administrative encumbrance, (4) stressing individual accountability for productivity and quality gains, and (5) emphasizing culture management by managers intimately familiar with the organization's core business.

In *A Passion for Excellence* (Peters and Austin, 1986), the role of innovation in corporate success is given particular attention. Drawing heavily from high technology firms, the authors postulate a model for innovation that probes a chaotic environment through vigorous experimentation by champions (called skunks) who operate in small autonomous groups (called skunkworks) which blend functions and have a strong results orientation. Emphasis also is given to tapping the expertise of innovative customers for new product ideas, a resource early recognized by von Hippel (1986).

High technology firms have been represented in cover stories on innovation featured in *Fortune* (Labich, 1988) and *Business Week* (Mitchell, 1989). Hewlett-Packard, Merck, and SmithKline Beckman were among several innovation luminaries surveyed. Keys to innovation success collectively reported by these two studies included keeping divisions small (H-P and 3M), liberally funding technical investigations (Merck, Corning Glass Works, 3M), and good interdivisional communication (SmithKline Beckman and Xerox).

Other firms in the studies linked their success as innovators to many of the factors previously found to underpin technology strategy. These include toleration of failure (3M, Johnson & Johnson), motivating product champions and entrepreneurism (3M and GE), involving customers in product development activity (3M, Johnson & Johnson, GE, Dow Corning), and managing with hands-on style (Monsanto).

A case study prepared by Richard King provides insight into strategic planning and control dynamics within Hewlett-Packard, a prominent high technology company (King, 1983). Several factors associated with its system for planning and control affirm themes prominent in the literature already reviewed. For example, integrative capability is emphasized by the restructuring activity of 1983 to better mesh its main product divisions and create an improved mix of marketing and engineering. Sales-support efforts also were given added emphasis to raise the quality of firm-customer interaction. Within the firm, liberal use of integrating mechanisms such as task forces, committees (councils), and teams (program management) has been a growing tradition.

Hewlett-Packard's posture regarding risk is reflected in its avid promotion of an **entrepreneurial spirit** throughout the organization. Existence of small product divisions figures prominently in efforts to maintain a small business climate. Individual freedom of action is another key to entrepreneurism that has been legitimized as a formal corporate objective. A strong technological orientation to strategic planning and control is evident from the firm's widely acknowledged commitment to technology and engineering excellence. R&D intensity is funded at one of the highest levels in the industry. It has a well-defined manufacturing strategy and continues to compile an enviable record of product development successes. Alliances with Apollo and Samsung give the company considerable prominence in the lucrative workstation technology area (Hill, 1989; *PC Week*, 1991).

The strategic planning and control system at Hewlett-Packard displays remarkable capability for enhancing organizational learning. It has brought this firm through lengthy periods of exceptional growth which precipitated frequent and significant organizational changes. The quality of these adjustments is underscored by the unswerving faith of employees in management's actions and, of course, a record of sustained success in the industry. Learning capability also is enhanced by the existence of small divisions which can adapt quickly to pressures for strategic change.

Widely-communicated corporate objectives help each employee share in the vision of what Hewlett-Packard is trying to become. There is also a **Management-By-Objective** (MBO) program which stresses goals rather than tactics to give flexibility in fulfilling the corporate vision. And, of course, the long tenure of founders Bill Hewlett and David Packard at the helm of this enterprise suggests sustained guidance by their collective vision. Successor John Young continues their tradition with a degree of excellence that

earned him an Executive of the Year award and qualified HP as best company in the electronics industry in 1989 (Cassidy and Dougherty, 1989; Greene, 1989).

Finally, there is evidence that strategic planning and control at Hewlett-Packard has a significant corporate culture orientation. The philosophy characterized as "the HP way" significantly influences how business is conducted in this company. It is the foundation for a culture that celebrates informality, trust, open communication, honesty, integrity, and individual initiative. Hewlett-Packard recognizes that its culture is a major key to success and nurtures it accordingly. Because this firm is widely regarded for its people orientation and healthy work environment, it continues to attract employees of the highest caliber.

Strategic planning pioneer General Electric is in the process of developing a new, highly simplified planning system reported to speed decision making in large organizations (Tichy and Charan, 1989). Fueled by managerial vision and candor about business challenges, it operates using frequent face-to-face meetings of corporate councils and business unit committees with a minimum of formal planning reports or corporate analytical studies. This system is predicated upon a flat organizational structure, wide spans of control (10-15), lean staff of facilitators rather than controllers, autonomous business units, and a corporate culture that permits subordinates to challenge superiors on any aspect of organizational activity that might be limiting performance. While GE's overall performance in recent years has been quite good by many measures, difficulties in some areas underscore the challenges of balancing delegation and control within this new system.

Jelinek and Schoonhoven (1990) studied attributes of strategic planning systems at five leading firms in the electronics industry: Hewlett-Packard Company, Intel Corporation, Motorola, Inc., National Semiconductor Corporation, and Texas Instruments, Inc. Several commonalities were found. All the firms accommodate frequent change by emphasizing planning rather the "the plan". Organizational structures are changed often. Long-term, strategic priorities rarely are sacrificed during periods of temporary economic duress which affect operational budgets. Individual input of "local knowledge" gives the planning processes a distinct bottom-up character. Highly accessible upper managements are the direction-setters, while details are left to those in close touch with markets, technology, etc. Decision processes are conspicuously open. Supportive here are strong, stabilizing corporate cultures which foster openness and a helpful degree of informality, preserving the feeling of a small company. Planning has a distinct technological orientation, with most firms actively formulating and implementing a discernible technology strategy. Risk-taking is encouraged and funding schemes (including boot-legging) always are available to support promising projects that surface between budgeting cycles. Catalytic in project selection are steering committees and cross-functional teams which provide appropriate guidance. Control is based more on outcomes and achievement of milestones than budgetary efficiency. Other factors

contributing to the success of these firms which repeat previous themes include technically-grounded managers, sharing of decision responsibilities (and risks), smooth integration of organizational units supporting the innovation process, maintaining technical liaison with customers, a strong corporate vision, and a healthy tolerance of failure.

Recent performance difficulties experienced by some prominent firms mentioned in this section might seem to erode their validity of key management prescriptions that have surfaced. For example, IBM, HP, and DEC are being pressed towards diminished roles in the computer industry, profit shrinkage, and shareholder defection (Wilsher, 1992; Weigner, 1990; Cusack, 1992). However, they remain prominent in this very demanding industry, and are restructuring themselves for a leaner, more responsive and competitive posture (Kirkpatrick, 1992; Hof, 1992). Many of the rejuvenative measures they are adopting reinforce the themes that organizational learning is vital to long-term success, and that corporate cultures potently influence the fortunes of high technology companies. Since aspects of corporate culture other than those cited here are being blamed for some of the turmoil these firms have experienced, validity of the culture prescriptions emerging from this literature remains intact.

E. SYNTHESIS OF RESEARCH LITERATURE

Perspective Iota: The literature review posits a high tech strategic planning and control model or species. In many respects it is a mutant, failing under the stresses of hyper-pacing of industry conduct, and blinded by the deep complication of product choices. In other respects, it is divine, showing how great vision and great values reference (anchor) the organization and stabilize its progress. The five emergent attributes of strategic planning and control may be considered transitional forms as the nature of business and society in millennial peace is contemplated. There will be a governing or service elite in Christ, deepest in knowledge of both secular and spiritual history, peaceful in problem and progress management, right and effectual with such reliability that God is affirmed by their judgments. Meeting God's expectations will supplant competition and strategizing. Fear will vacate the business world. Inspiration within a context of a loving, familial God who meets every need will buoy every organization, every individual. High tech exists at the problematic fringe of industry, but also is nearer history's consummate synthesis.

William C. Patterson
Ph.D.

Perspective Iota.WMA

*They shall **hunger no more**, **neither thirst any more**; neither shall the sun light on them, nor any heat. For **the Lamb which is in the midst of the throne shall feed them**, and shall **lead them unto living fountains of waters**: and God shall **wipe away all tears from their eyes**. Revelation:7.16-17*

The literature reviewed appears to support existence of a distinctive model for strategic planning and control in high technology contexts. Perspectives on the environment, strategic planning, strategic control, and strategic planning and control system attributes appear to contrast with corresponding concepts and attributes drawn from the mainstream of strategy literature.

Major contrasts between the traditional model and the high technology model for strategic planning and control are elaborated in Table 1, beginning on page 30. Illustrative references are given for both models. Because the literature review was not intended to provide exhaustive analyses of the traditional model, references not previously cited sometimes are used to support that perspective. Only those suggested (by contrast) from major features of the emergent high technology model are included. A more rigorous elaboration of the traditional model has been offered by Henry Mintzberg within the context of what he calls the "design school" model (Mintzberg, 1990).

The concept of the environment has noticeably different shadings in the high technology model than in the traditional model. Although Dess and Beard's (1984) work reveals the multidimensional nature of business environments, their data also show that most industries are positioned on the stable and simple side of the environmental spectrum. Furthermore, industrial organization theorists like Porter (1980) predicate their strategy research and prescriptions on being able to exhaustively analyze an industry, a process that becomes rather futile when stability and simplicity are sacrificed to the point that measurability is impaired and contextual knowledge is highly transitory. Widening use of environmental analysis groups and techniques (Klein and Linneman, 1984) further attests to the existence of many environments amenable to prediction. Accordingly, environment in the traditional model stands in contrast to the high technology environment where many environmental variables are at their problematic extremes and knowledge is extractable in such tiny fragments that prediction is largely frustrated (Tosi et al., 1973; Snyder and Glueck, 1982; Bahrami and Evans, 1989).

A logical consequence of the relatively predictable environment of the traditional model is ability to interrogate the environment for opportunities and threats, and subsequently integrate this information into a formal, comprehensive process of analysis that yields a planned corporate strategy. Basic literature in the strategy field promotes this type of analytical framework (Learned et al., 1965; Ansoff, 1965; Hofer and Schendel, 1978). Modern prescriptions for managing both integrated and diversified organizations continue to rely on a strong formalized logic (Grant and King, 1982). A less orderly process of managerial experimentation which superimposes strategy formulation and implementation characterizes the high technology model. Here, an abiding top management vision imprints a type of rationality on strategic planning activity (Bahrami and Evans, 1989; Quinn, 1985).

Because the environment is essentially predictable and strategy may be formulated analytically *a priori*, control in the traditional model is largely a matter of making sure implementation proceeds as planned. It, therefore, tends to be formalized and rigid, with little questioning of the prescribed strategy (Camillus, 1986; Schendel and Hofer, 1979; Amigoni, 1978). The experimental nature of strategizing in the high technology model places a premium upon rapid organizational learning, and demands a readiness to question the extant strategy (Schreyogg and Steinmann, 1987; Argyris, 1977; Lorange et

al., 1986). Control is driven by superordinate goals that permit considerable discretion at lower levels where information and solutions to problems must be free to circulate and rise to the top of the organization. A "loose" control style functions well here and performance is keyed more to technology and marketing criteria than financial criteria (Amigoni, 1978; Sommers et al., 1987).

Strategic planning and control system attributes in the high technology model also appear to be distinctive. Success depends greatly on free-flowing information and unimpeded collaboration on problems that is facilitated by a strategic planning and control system with substantial integrative capability. In the traditional model, linkage between the market and the firm emerges as the primary concern (Schoeffler et al., 1975; Burnett et al., 1984). Attaining financial synergy in relationships among strategic business units also is a top priority (Henderson, 1973). However, several internal and external entities must be extremely well integrated in a finely-tuned network of planning and control if the high technology firm is to be successful. Both formal and informal mechanisms are invoked to link customers and suppliers with the firm's strategic planning and control process, and to effectively integrate R&D, marketing, manufacturing, engineering and related technical and commercial specialties within the firm (Porter, 1985; Souder, 1987; Ettlie, 1988; Frohman, 1982; McGinnis and Ackleserg, 1983; Quinn, 1985).

Risk is another attribute distinguishing strategic planning and control systems between the two models. Strategic planning and control systems operating in high technology firms promote risk-taking mainly by identifying, motivating positively rather than punitively, and providing resources for entrepreneurial product/process champions (Maidique, 1980; Sherman, 1984; Quinn, 1985; Maidique and Hayes, 1984). The successful system keeps highly-qualified professionals pressing for successes in a context where failure is the more likely outcome. This contrasts with the value-based systems in traditional business settings that emphasize financial hurdle rates, and which become ever more selective (and risk-averse) when outcome predictability or stability erodes (Hax and Majluf, 1984; Reimann, 1987).

A key distinction between systems in this dual typology pertains to the focus on technology. In the high technology firm, technology is the key to business success. Opportunity is technologically driven and technical knowledge fuels the engine of competitive advantage. Accordingly, a technically-oriented management team proceeding with a "hands-on" style continually nurtures the firm's technological competence (Sherman, 1984; Frohman, 1982). Technologists probe for exploitable business opportunities in all phases of the firm's business, and a variety of external sources and arrangements are engaged to generate technical knowledge potentially applicable to the business (Frohman, 1982; Quinn, 1985; Dewar and Dutton, 1986). In traditional business settings, technology usually is subordinated to marketing or financial priorities that are managed largely through formal mechanisms (Hayes and Abernathy, 1980).

Strategic planning and control systems operating in traditional business contexts mainly are configured for learning to be "front-loaded", that is, during the analytical and somewhat politicized phase of the process (Schendel and Hofer, 1979). Environmental stability and simplicity permit this to occur and foster adoption of a more mechanistic system to promote conforming behavior during implementation (Burns and Stalker, 1961). By contrast, organizational learning in high technology contexts is concurrent or "rear-loaded" and time-critical. Environmental uncertainties dictate a high degree of strategic experimentation, and competitive realities require anticipation of change and flexibility (Maidique and Hayes, 1984; Quinn, 1985). This calls for an open process, relatively unimpeded by politics and adept at double-loop rather than single-loop learning (Souder, 1987; Argyris and Schon, 1978).

In most business environments, firms exhibit lengthy periods of strategic stability punctuated by short periods of unrest during which their strategies and structures are reconstituted to accommodate new environmental conditions (Miller and Friesen, 1980). System formality helps to maintain strategic stability during periods of relative equilibrium between the firm and its environment, and can stifle adaptation when events finally signal a pressing need for change (Burns and Stalker, 1961). In the continuous upheaval of the high technology environment, strategies continually undergo alteration. The prime source of stability comes from a high-order vision communicated by top management (Bahrami and Evans, 1988; Quinn, 1985; Sherman, 1984). This vision brings order to what might otherwise be construed as chaos, and rallies the organization to persist in its quest for success despite frequent set-backs.

Most business organizations are amenable to control by bureaucratic mechanisms as a result of their relatively benign environmental context. In such settings, organizational culture tends to play a lesser role than administration as a control mechanism (Ouchi, 1979). However, in high technology firms where environmental and internal forces for change seemingly frustrate formalized administration, organizational culture provides the prime basis for governance. Behavioral commitments are made to ideals such as communicative openness or tolerance of others which figure prominently in long-term success of the organization (Quinn, 1985; Souder, 1987; McGinnis and Acklesberg, 1983; Sherman, 1984). Not unlike the corporate vision, this gestalt of principles and values assumes primary importance, both as a key to management and as a rallying point for employees.

The evident conclusion from literature relevant to strategic planning and control in a high technology context is that strategic planning and strategic control are distinctively conceptualized largely as a result of the unique nature of the high technology environment. Furthermore, the strategic planning and control system exhibits particular attributes that are responsive to this peculiar environment, and which form an internally consistent set. Relative to strategic planning and control systems of traditional business,

high technology systems appear to be distinguished by much greater capability at integrating diverse system inputs, stronger promotion of risk-taking, deeper involvement in technology, greater facility at organizational learning , more reliance on the corporate vision, and a more active role for corporate culture.

Table 1

Major Contrasts Relating to Strategic Planning and Control In Traditional Business versus High Technology Contexts

Panel A

Concept of the **Environment**

Traditional	The environment tends toward linearity and is highly measurable, synoptically knowable, and largely predictable (Porter, 1980; Klein and Linneman, 1984; Dess and Beard, 1984).
High Technology	The environment is technologically-driven, essentially multidimensional, resistant to measurement, incrementally knowable, and relatively unpredictable (Tosi et al., 1973; Snyder and Glueck, 1982; Bahrami and Evans, 1989).

William C. Patterson Ph.D.

Environment.WMA

The natural environment has not changed, only man's operation within it. In high technology, he has set a perishing pace and complicated problem-solving such that it has not time to resolve in a comfortable, effective way. Man's forecasting from this high-speed vessel falters and fails, though God's foreknowledge does not. Good men properly trained will do better in this sea of unrest, but only the Captain of our Salvation, the Lord Jesus Christ, the Inner Holy Spirit, keeps society and industry afloat in our self-made storm. At issue: Why keep zeal for material and power so swift and dangerous? Is life not wonderful at a slower, more sober pace?

This Is My Father's World,
And to my list'ning ears,
All nature sings, and round me rings
The Music of the spheres.

This Is My Father's World,
O let me ne'er forget
That though the wrong seems oft so strong,
God is the ruler yet.

Table 1 Major Contrasts Relating to Strategic Planning and Control In Traditional Business versus High Technology Contexts	
Panel B Concept of **Planning**	
Traditional	Strategy is comprehensively determined *a priori* by formally analyzing strengths, weaknesses, opportunities, and threats within the context of clearly defined purpose (i.e., mission and objectives). (Learned et al., 1965; Ansoff, 1965; Hofer and Schendel, 1978; Grant and King, 1982).
High Technology	Strategy is crafted gradually through experimentation within the context of a strong entrepreneurial vision (Bahrami and Evans, 1989; Quinn, 1985).
 **William C. Patterson Ph.D.** Planning.WMA	*As the knowledge of business administration has grown, it has demonstrated unprecedented power to meet needs locally, nationally, and internationally. The principles involved are learnable, generalizable, and confer much foresight. New, high tech products embrace the speed-of-light dimension with sophistication few deeply understand. Some press forward competitively, raising uncertainty, raising anxiety, letting whirl-wind activity substitute for wisdom. Defensive racing shortens the planning horizon, consequently blinding managers. Progress becomes tentative, as though feeling one's way, and spiritual eyesight (vision) moves into the management picture. So much of high tech is invisible. The visionary shift emerges as a kind of faith. Many confessing faith in God testify of a time of faltering where God has rescued them and becomes more real in understanding life's transcendent meaning. The planning shift to vision and character generalizes the spiritual experience from individual to corporation. It is a collective occasion to trust God more in business, promote Christ in problem-solving, and adopt a mature, confident attitude about futures. Racing is the lesser strategy, ill-advised for firms and societies who know that Almighty God holds their place surely.* **He *brought me* forth also *into a large place*; he delivered me, because he delighted in me. Psalm:18.19**

Table 1 Major Contrasts Relating to Strategic Planning and Control In Traditional Business versus High Technology Contexts	
Panel C Concept of **Control**	
Traditional	Control is relatively rigid, feeds back primarily financial information, operates using formal procedures which tend to promote a "tight" operating style, and facilitates single-loop learning. (Camillus, 1986; Schendel and Hofer, 1979; Amigoni, 1978).
High Technology	Control is highly adaptive and feedforward, facilitates double-loop learning, culturally promotes a "loose" operating style, and focuses on technological and market performance (Schreogg and Steinmann, 1987; Argyris, 1977; Amigoni, 1978; Sommers et al., 1988; Lorange et al., 1986).
 **William C. Patterson Ph.D.** Control.WMA	*When the Rational Model of management, that which presumes to see and understand all necessary things, founders and degrades, accuracy of control likewise degrades and complicates. In the residual uneasiness, managers compensate for knowing by tentativeness, presumptiveness, acting confident, and cheering on. Requisite control of complexity is by looking beyond control finances to deeper causality in technology change and market dynamics. Less evident in high tech accommodation to less rationalizable planning is rise of a Control Culture (e.g., the Excellence Culture), which simply sets targets and compels managers to reach them, unequipped by a proven process. The intelligencia of high tech probes and grasps the uncertainties more deeply, but reliance on person, character, vision, culture, even faith, colors much of the control phenomenon. Spiritually, eyesight for these waters and requisite judgment of the signals is manageable by God, the Mind of Christ, and the Holy who God leads and protects. Downpacing is prudent for improving the control function, but surest of all is putting the high tech organization under God's control, under God's best men, under a culture of sacred trust.* **I will instruct thee and teach thee in the way which thou shalt go: I will *guide thee with mine eye*. Psalm:32.8**

Table 1

Major Contrasts Relating to Strategic Planning and Control In Traditional Business versus High Technology Contexts

Panel D

Strategic Planning and Control System: **Integrative Capability**

Traditional	Emphasis is on achieving financial synergy among SBUs and using marketing strategy to moderate the firm-market relationship, primarily via formal mechanisms (Henderson, 1973; Schoeffler et al., 1975; Burnett et al., 1984).
High Technology	Emphasis is on technology strategy in relationships with customers and suppliers, and with technical and commercial entities within the firm, using both formal and informal mechanisms. (Porter, 1985; Souder, 1983, 1987; Ettlie, 1988; Frohman, 1982; McGinnis and Acklesberg, 1983; Quinn, 1985).

William C. Patterson Ph.D.

Integrative Capability.WMA

Early business life engaged hard work, but few relationships. High tech operates more like a sophisticated cell or organ of the body, with many interconnects and intrafunctional processes. Higher intelligence is needed, and superhuman capacities are beckoned (e.g., clairvoyance). Coordination within this more demanding regime requires faculties that rise above the natural dimension. Physically-dominated perspectives view these times as an occasion to promote an aggressive Master Race, like the Aryan movement embraced by Germany when they could not solve their economic problems pre-World War II. Spiritually-motivated analyses regard today's complexities as beckoning a Christ-centered organization, what the Holy Bible refers to as the Body of Christ. This spiritual entity raised up the global church (now in nearly every country) from a seed of one gentleman and twelve personally-selected disciples, without investment capital or transportation beyond walking (two-by-two). No business or empire of history matches the growth and unifying capability of Jesus Christ's Church, official Body of Christ. Integrating its moves and directing its growth is God's infinite mind (Mind of Christ). With power to reach forward in time to solve problems of the moment, this supernatural resource is the divine answer for high tech management, planning and control, and integrating capability. In the Spirit of God is found Oneness out of differentia. The Holy Spirit is the Great Integrator.

There are *differences of administrations*, but the same Lord. And there are *diversities of operations*, but it is the same God which worketh all in all . . . dividing to every man severally as he will. For *as the body is one*, and hath many members, and all the members of that one body, being many, are one body: *so also is Christ (without schism)*.

1 Corinthinians:12.5-25

Table 1 **Major Contrasts Relating to Strategic Planning and Control In Traditional Business versus High Technology Contexts**	
Panel E Strategic Planning and Control System: **Risk Accommodation**	
Traditional	Primarily financial criteria emphasizing risk-aversion are used to analyze business as investment opportunities (Hax and Majluf, 1984; Reimann, 1987).
High Technology	Entrepreneurial product/process champions absorb risk within the context of a non-punitive system which liberally funds experimentation (Maidique, 1980; Sherman, 1984; Quinn, 1985; Maidique and Hayes, 1984).
 **William C. Patterson Ph.D.** Risk Accommodation.WMA	*Under the orderly conditions of traditional strategic management, the exercise of business acumen is fully rational with adequately supplied knowledge. High tech represents a recession from rationality and elevation of riskiness. As the management domain darkens, God works among men to supply guidance using His tradition of individualism. Emergence of qualified insight is evidence of the divine. The lonesome nature of such service also reveals the divine tradition of self-sacrifice with courage. Note also the success enhancer of non-punitiveness. When God does provide relief, deliverance, salvation, etc., His men are to be accorded high respect, ease of mind, that they may follow the will of God sans coercion, deterrence, or fear. While America has a rich tradition in Christianity, downgrading of the spiritual side of men or business or society has emerged in the 20th Century. Men less chosen by God, less confident in His leading, decide and move more tentatively, experiment more often, pray less, trust less, fail more. Promising in the Biblical prophecy of worldwide Millennial Peace is ascension of Christ over the affairs of man, flawless foresight, and fearless trust that God will take care of every need without sorrow.* **Who hath believed our report? And *to whom is the arm of the LORD revealed?*. . . Surely he hath borne our griefs, and carried our sorrows (Isaiah:53.1-4). For in the time of trouble . . . *he shall set me up upon a rock*. And now shall *mine head be lifted up*. Psalm:27.5-6**

Table 1

Major Contrasts Relating to Strategic Planning and Control In Traditional Business versus High Technology Contexts

Panel F

Strategic Planning and Control System: **Technological Knowledge Focus**

Traditional	Management is financially-oriented or marketing-oriented and somewhat remote, with a focus on the commercial aspects of the business (Hayes and Abernathy, 1980).
High Technology	Management is technically-oriented with a "hands-on" style, and constantly nurtures the technology base of the organization (Frohman, 1982; Sherman, 1984; Quinn, 1985; Dewar and Dutton, 1986).

William C. Patterson Ph.D.

Technical Knowledge Focus.WMA

In the tradition of business, finances are the circulatory system of value connecting the whole of firm and environment and time. More recently, market has become dominating because of unsurpassed prosperity, though a partial management function. With high technology enterprise, very narrow knowledge, historically from the R&D and production functions, now leverages great wealth in the market and sets pace in the time domain. It is pre-eminent knowledge work, a specialist's holiday, and introduces the epoch of trust. Private information won by education and superior intellect controls high tech fortunes. Only faultless character earns trust worthily, and 24-hour-a-day commitment keeps on top of things. These bring into focus aspects of Godliness (character perfection, sleepless caring, omniscience, and omnipresence) as needful to survive and prosper. Many signs today point to the return of Christ, and the high-tech arena of business joins in that beckoning. It is Christian character that performs in powerful high technology with success, liberty, and happiness. As the world turns in a whirlwind of technical change, all-knowing God in Christ becomes the immovable center of reference.

When I rise to worlds unknown,
And behold Thee on Thy throne,
Rock of Ages, cleft for me,
Let me hide myself in Thee.

Table 1

Major Contrasts Relating to Strategic Planning and Control In Traditional Business versus High Technology Contexts

Panel G

Strategic Planning and Control System: **Organizational Learning Enhancement**

Traditional	Organizational systems tend to be bureaucratic, with strategy emerging *a priori* from a systematic, politicized process that fosters single-loop learning and epochal change (Schendel and Hofer, 1979; Burns and Stalker, 1961; Shrivastava and Grant, 1985).
High Technology	Organizatinal systems favor experimentation, anticipatory feedback, flexibility, openness, and double-loop learning (Argyris and Schon, 1978; deGeus, 1988; Maidique and Hayes, 1984; Quinn, 1985; Souder, 1987; Huber, 1991).

William C. Patterson Ph.D.

Organizational Learning Enhancement.WMA

Need to learn accompanies developmental processes, things in disequilibrium, matters in a state of flux. They may be contrasted with mature processes, fully trained, fully educated, and stable. Newness of the high-tech frontier in business attaches a premium to learning that redeems for higher value in the marketplace. Firms, industries, and nations chasing those rewards without restraint create a chaotic race for answers that become obsolete before they reach their state of fruition. While computing and telecommunications eases the burden of hyper-pacing, the high-tech ecology remains threatened, laden with organizational casualties, rapid entity turnover, and destructive of capital. One is led to conclude that organizational learning brings rewards, but that no one learns fast enough to survive easily. Pace reduction will bring learning into a more humane and organizationally kind setting. Transcending the present milieu, and promising a comfortable equilibrium eventually is putting the organizational learning process under God. Our Creator is not bound by time. To the Great I Am *(Exodus:3.14), everything is present tense. Accordingly, those individuals, corporations, and nations that place their confidence in Him, tap a mind that already knows all the answers. Divine love, in Christ, promises to share the answers with those who love Him, love measured by obedience. This does not obsolete education. Rather, it affirms it, since knowledge revealed by God in times past should be mastered before seeking answers to emergent problems. Best leadership composes as those highly educated and mature in Christ. The doctoral fraternity,* the philosophium, *is reminded that the Lord completes our learning so lovingly pursued. This divine consummation of learning underpins my motive for belatedly bringing sharable Christian Perspectives to this dissertation.*

***I am the way, the truth, and the life*:**
No man cometh unto the Father, but by me. John:14.6

Table 1

Major Contrasts Relating to Strategic Planning and Control In Traditional Business versus High Technology Contexts

Panel H

Strategic Planning and Control System: **Vision Projection**

Traditional	Administrative systems and the management team motivate and stabilize the organization through relatively lengthy periods of strategic equilibrium (Burns and Stalker, 1961; Miller and Friesen, 1980).
High Technology	Visionary leadership by the top manager or managers motivates the organization toward general goals and stimulates perseverance during relatively frequent periods of commercial instability (Bahrami and Evans, 1988; Quinn, 1985; Sherman, 1984; Camillus, 1988).

William C. Patterson Ph.D.

Vision Projection.WMA

Traditional business navigated through placid waters. High tech captains deal with clouded skies and stormy seas. Everyone sees in clear weather, but only a few can move through darkness and rough water. The vision process of today is not so different from what Biblical truth teaches about foreseeing. Like the prophets, individuals are the unit of analysis, the variable with effect. Less clear now, but well-testified by history, is that holy men are the ones who see futures most clearly. The Godly approach God, receive His favor, discharge His services to mankind worthy for representation and wieldable as instrumentation. Like God, they more noticeably rise to the occasion in times of trouble. Sadly, greed and emotionalism have whipped up industrial life, now fitted with Godspeed technology. Greatest visionaries will counsel slowing down the pace of high tech industry, declaring soundly against abuse of power, and proceeding safely to still waters and green pastures reserved by God for His lambs (gentlemen).

Where there is *no vision, the people perish*: but he that keepeth the law (the holy), happy is he. Proverbs:29.18 If there come any unto you, and bring not this doctrine, receive him not into your house, neither bid him God speed:For *he that biddeth him God speed is partaker of his evil deeds*. 2 John:1.10-11 The LORD is my shepherd; *I shall not want* (I shall not be in need). He maketh me to lie down in *green pastures*: he leadeth me beside the *still waters*. Psalm:23.1-2

Table 1

Major Contrasts Relating to Strategic Planning and Control In Traditional Business versus High Technology Contexts

Panel I

Strategic Planning and Control System: **Corporate Culture Salience**

Traditional	Corporate culture is subordinate to administrative systems in prescribing behavior, and tends to be passive (Ouchi, 1979).
High Technology	Corporate culture is actively managed to promote openness and cooperation, nurture creatives, and provide key general guidelines for organizational behavior, which extend to tolerating the unusual (Quinn, 1985; Souder, 1987; McGinnis and Acklesberg, 1983; Sherman, 1984; Kilmann, 1985).

William C. Patterson Ph.D.

Corporate Culture Salience.WMA

Transition to high technology enterprise has brought a transition in governance from administrative policy (the law) to corporate culture (the spirit). While the latter may be managed to some degree, if lawful conduct is the standard, highest performance will center on the very character of God. Consider this spiritual interpretation by the promotive concepts involved: Openness *relates to* truth, *an attribute of God.* Cooperation *is a ministry of the Holy Spirit, God's force for* Oneness. *Support of* creatives *inwardly honors the consummate builder character of our* Creator. *The* toleration *value can be construed as* Acceptivity, *which is divine, as God accepts every man as he is (Americans may remember the call to Christ after every Crusade of Evangelist Billy Graham offered by the hymn:* Just as I Am). *These affirmed cultural values are touchpoints in the character of God. Firms can only become more successful as full godliness (sanctification) is managed into the corporate culture. In Christ, the process actually is self-managing. Under this aegis, leading proceeds at the higher, spiritual level, God providing vision, implementation power, perseverance, and success, even beyond human capability. Proactivity can be invoked for cultural development by the process of prayer: asking God for things needful in business service life (something the Godly do regularly in personal life). The divine promise is to provide what is asked for if there is conformance to Godliness Culture.*

But the fruit of the Spirit is *love, joy, peace, longsuffering (perseverance), gentleness, goodness, faith, meekness (no abuse of power), temperance (self-control)*: against such there is no law. Galations:5.22-23 If ye abide in me, and my words abide in you, ye shall *ask what ye will, and it shall be done unto you*. John:15.7

Chapter III
CONCEPTUAL FRAMEWORK

The literature review of the previous chapter began the process of assembling relevant conceptual material, and this chapter furthers that process by introducing a framework that fundamentally underpins the design of the research effort. An elaborated framework tailored to address the research problem at hand is then presented and used as the basis for the five hypotheses that are proposed.

Perspective Kappa: The industrial organization model of business is a deterministic construct giving industrial age businessmen a sense of ideality and predictability in developing an industry. Suit the business to the environment as the central organizational strategy, and performance optimizes. Economist do not set the goal of profit maximization so much as claiming that managing for efficiency will produce stable, enduring revenues and sufficient income to continually renew the business. Competitive strategists of more recent prominence found they could extract unusual profits by inter-firm ploys and schemes. Business law limits interplay strategies to some degree, but the tendency to extort payments via gamesmanship grew popular in the business ethic of the late 20th Century. Sadly, this has robbed America and other advanced societies of much economic progress. Big business and industry, through economies of scale and refined management, could have delivered best prices in history on amazing factory products, raising the standard of living to highest in world history. High tech and consummate economic intelligence (moving by the invisible hand of efficiency) should have been able to generate world economies in every Christian nation with shortest work week ever, lowest product prices ever, and broadest selection ever. The rise of empty competition and predative behavior has squandered the margin of efficiency that would have moved us toward easy living for all. Interestingly, Jesus Christ promised that the Children of God should live **free** in His Kingdom of Heaven on Earth. Evident in the latest episode of industrial economics is failure to invest Christ in and supremely over the Structure-Conduct-Performance tradition. If dark-side high technology in weapons of mass destruction deliverable at lightening speed, or corruptive use of surveillance electronics to invade privacy do not take us from the Earth prematurely, there remains blessed hope for Christ-centered economics and business policy that will allow us to live the abundant life freely.

William C. Patterson Ph.D.

Perspective Kappa.WMA

And when they were come to Capernaum, they that received tribute money came to Peter, and said, Doth not your master pay tribute? He saith, Yes. And when he was come into the house, Jesus prevented (approached) him, saying, What thinkest thou, Simon? Of whom do the kings of the earth take custom or tribute? Of their own children, or of strangers? Peter saith unto him, Of strangers. Jesus saith unto him, ***Then are the children free****. Matthew:17.24-26*

A. ORIENTING PARADIGM

Although strategy **content** receives parallel treatment, the research emphasis of this study is the strategic **process**, as manifested by the strategic planning and control systems used by high technology firms. Because of its extreme complexity, dynamism, and

uncertainty, the environment also figures prominently in the overall framework. Pursuit of a normative orientation requires that attention be given to performance consequences, as well. Conceptually, strategy process can be viewed as an intermediate variable in a causal linkage involving both the environment and firm performance. This produces a model structured according to the familiar ***industrial organization*** paradigm (Bain, 1956):

STRUCTURE → CONDUCT → PERFORMANCE

Presented in Figure 1, on page 47, is an adapted version of the classic industrial organization model, which serves as the framework for this dissertation research. Each component will be explained in the following sections.

1. Environment

The underlying presumption of the industrial organization model is that the environment (industry structure) determines firm strategy and, ultimately, performance (Bain, 1956). More recently, research has shown that strategy influences the environment, as well, through erection of barriers such as economies of scale (Porter, 1981). The emerging convention of treating the environment as both a cause and an effect is incorporated into this research.

Organizational theorists generally are credited with assigning the attributes of complexity, dynamism, and uncertainty to business environments (Dill, 1958; Burns and Stalker, 1961; Emery and Trist, 1965; Thompson, 1967; Lawrence and Lorsch, 1967; Perrow, 1967; and Duncan, 1972). Firms facing high levels of complexity, dynamism, or uncertainty encounter significant management challenges. Uniqueness is ascribed to environments in this research because their extensive and changing technological content contributes strongly to high scores on each of these three dimensions.

Consider the issue of **complexity**. Duncan (1972) ascribes complexity to environments when firms face a large number of diverse factors in making decisions within that context. High technology industries are producing sophisticated products like pharmaceuticals, computers, scientific instruments, and aircraft. The mere task of comprehending products and manufacturing processes often is problematic in these industries. It takes technically astute individuals and sophisticated equipment even to begin recognizing opportunities and threats woven into product technology alone.

Duncan (1972) ascribes **dynamism** to an environment if factors in both internal and external environments are in a process of continual change. Dynamism in high technology industries also appears to be technologically driven. High R&D expenditures provide constant impetus for change. This is quite evident from the example of microprocessor development rate in the computer industry. In 1993, desktop computer

manufacturers are launching the fifth generation of new product designs in an industry segment little more than a dozen years old (Rosch, 1992).

Uncertainty can be defined as:

> (1) the lack of information regarding the environmental factors associated with a given decision-making situation, (2) not knowing the outcome of a specific decision in terms of how much the organization would lose if the decision were incorrect, and (3) inability to assign probabilities with any degree of confidence with regard to how environmental factors are going to affect the success or failure of the decision unit in performing its function (Duncan, 1972:318).

Again, technology appears to be the primary contributor to uncertainty in most high technology domains. When a firm is producing and selling new products embodying new technology for new customers in environments where competitors rapidly come and go, managers seldom have hard information for decisionmaking. Technological, market, competitive, and arena uncertainties are regarded as common among those pursuing high-technology enterprise (Bahrami and Evans, 1989).

The concept of **volatility** sometimes has been used to capture the essence of the aforementioned characteristics of uncertainty, dynamism, and complexity. Tosi et al. (1973) operationalized the construct in terms of market, technological, and earnings volatility, and found high technology industries to be among the most volatile. In another empirical evaluation of the measure (less the earnings volatility component), Snyder and Glueck (1982) also found high technology industries to be highly volatile. In the same study, these industries also ranked high on volatility based on *perceptions* of industry analysts relative to both technological and market factors.

2. Strategic Planning and Control System (SPCS)

The notion of **conduct** in the classic industrial organization paradigm has come to be regarded by some as synonymous with strategy. This evolution of terminology has not brought with it definitional clarity. Strategy is a complex term with many facets and shadings (Hatten and Schendel, 1975-76; Anderson and Paine, 1978; Mintzberg, 1990). Descriptive literature deals with strategy as a process and recognizes the dual components of strategy formulation and strategy implementation (Bourgeois, 1980). The former falls precisely within the domain of planning, and the latter is concerned with administration or execution of the plan. Although some researchers regard control as part of implementation, the view taken here will be that formulation, implementation, and control are distinct conceptual entities amenable to separate analysis. This approach is recognized in some conceptualizations of strategic management (Schendel and Hofer, 1979; Grant, 1988).

Perspective Lambda: It is necessary to distinguish the concepts to be studied in this research, that no important term be confused and that conclusions rest upon well-delineated causality. An important observation rising above the clarifying work of this section has to do with the emergent marriage of planning to control in strategic thinking. Early practitioner support of strategic management originated as corporate planning or strategic planning groups. Often these were mini-think-tanks in big organizations to shoulder some of the analytical burden of top management. Many corporations cycled their most promising managers through such groups for seasoning. This later academic research cast in a high-technology environment acknowledges more recent emergence of a control emphasis in the strategy conceptual field. It is philosophically illuminating to ponder why. Great minds and top managers plan. Well-disciplined, lower level controllers and accountants control. However, when the task of planning transcends the cognitive and information-processing capability of corporate intelligencia, reductionism occurs. The balance of activity shifts in favor of easier control duties. The sense of the matter is that one may be less able to tell the organization what to do to be successful, but management may be able to tell it what measures of success it has to meet to be successful. The Excellence School of management is this way. For example, managers and organizations are told what sales and profit levels they must meet, while the way to it left up to them. If they fail, there are set aside and the next candidates drafted. It is worthy to note that the management task becomes colder as the environment for it becomes less tractable. Consider it overarching counsel to slow down the pace of high-tech society to keep the business world humane. Consider also that man's reversion to cold management is rather opposite the Christian counsel of leaning more on God when things grow uncertain.

William C. Patterson Ph.D.

Perspective Lambda.WMA

*My son, **forget not my law**; but let thine heart **keep my commandments**: For length of days, and **long life, and peace, shall they add** to thee. **Let not mercy and truth forsake thee**: bind them about thy neck; write them upon the table of thine heart: So shalt thou find favour and good understanding in the sight of God and man. **Trust in the LORD** with all thine heart; and **lean not unto thine own understanding**. In all thy ways **acknowledge him**, and **he shall direct thy paths**. Proverbs:3.1-6*

The intended focus on strategic planning and control systems suggests that implementation is de-emphasized. This is apparently true, but actually false. The perspective taken here is that implementation is largely the ongoing task of administrative management – what all managers are paid to do. Thompson and Strickland (1987) basically endorse this view. It is a responsibility of strategic control, however, to see that administration of the strategic plan proceeds effectively. So attention to implementation is indirect.

The conceptualization thus far applies to firms in general. When these strategic planning and control systems exist in organizations that interface with an environment where technology is salient, then distinctive SPCS characteristics are expected. Determining these distinctions and how they impact firm performance is central to this research effort.

Because strategy content factors also are addressed in this research, and to make clear that many other dimensions of strategic choice moderate the environment-performance

relationship, the conduct element of Figure 1 on page 47 is dichotomized. The choice areas noted are not exhaustive.

3. Performance

Perspective Mu: Performance is the measure of men, organizations, and societies. How performance is operationalized is critical, as such means determine the target and destination. Modern American business looks at performance diversely. Popular are rewards per unit of time, rewards per unit of capital, rewards on the margin of effort or expense. Some measures reward on the basis of expectations or vision. Some measures consider rewards only if rewards are increasing. One cannot disregard these primarily monetary themes, as they have economically driven our nation higher and faster than any in history. However, they also have over-driven our economy and societal character on an increasingly dispassionate treadmill. Materialism has been quenching national capacity to love. Economic momentum blinds our eyes to matters of spiritual progress. Wealth re-invests in the wealthy, rather than making the lesser greater in the global fraternity of servanthood. U.S. self-indulgence, unsatisfiable quest for material wealth, and fall to insensitive power abuse has damaged national character. High anxiety, depression, emotional bi-polarism, expedience thinking, taking over (not giving to) others, and desperate resort to crime, soil the robe of our blessed, righteous nation under God. Biblical counsel on prosperity gives way to God and His chosen **priesthood** of wise and holy men. They are the investment focus. Give them a dollar, and they will return ten dollars. Live moderately, caring for others more than yourself. Cheerfully divert the best and first tenth of your abundance (profit defined as rewards in excess of needs) to God's economy and overseers (those discernible servants He ordains for your well being), and you will prosper enduringly. He guarantees that there always will be enough to support His stewards. Through their divine eyesight (enlightment) cornucopia flows, peace maintains, and health magnifies. After so many wars, depressions, recessions, criminalities, diseases, disappointments, notorious corruption, etc., it stretches one's faith to imagine a world of peace and joy and satisified people. Yet, God has foretold it, indicated the order of it, and explained the performance criteria. Simple faith, righteous living, love for all men, moderation, will give on 10% what 50% taxation could not do, and what inflationary, cycling, racing, or 10% industry profiteering did not do.

William C. Patterson Ph.D.

Perspective Mu.WMA

*Therefore take no thought, saying, What shall we eat? Or, What shall we drink? Or, Wherewithal shall we be clothed? (For after all these things do the Gentiles seek) for your heavenly Father knoweth that ye have need of all these things. But **seek ye first the kingdom of God, and his righteousness**; and all these things shall be added unto you. Matthew:6.31-33 They that **wait upon the LORD shall renew their strength**; they shall mount up with wings as eagles; they shall run, and not be weary; and they shall walk, and not faint. Isaiah:40.31*

Strategic performance has been regularly addressed and appraised by diverse measures in the strategy literature (Venkatraman and Ramanujam, 1986). Sommers et al. (1987) claim that in high technology business, performance emphasis is on new product generation, market share, technological positioning, and risk-taking moreso than on financial measures. In a recent study of the computer industry, Chakravarthy (1986) evaluated use of conventional profitability measures (return on sales, return on total

capital, return on equity), capital market measures (market-to-book ratio), composite measures, measures of stakeholder satisfaction, and measures of the quality with which the firm transforms itself to accommodate new challenges. He concludes that no single representation of performance is adequate for strategic studies. Accordingly, performance is measured diversely in this study.

B. THEORETICAL PROPOSITIONS

There are two theoretical propositions that directly or indirectly relate to the research question to be answered by this study. Collectively, these propositions define the theoretical domain and general relationships of interest.

Proposition 1: *The technological component of the environment in high technology industries creates a context of extreme complexity, dynamism, and uncertainty for strategic management.*

This proposition was informally introduced in the process of specifying the orienting framework for this research. The qualities of complexity, dynamism, and uncertainty have been attributed to environments by organizational theorists (Dill, 1958; Burns and Stalker, 1961; Lawrence and Lorsch, 1967; Thompson, 1967; Duncan, 1972). Some imply a connection between technological salience and high levels of these environmental qualities (Burns and Stalker, 1961; Woodward, 1965; Perrow, 1967). The logic and general descriptive evidence presented in the previous section is the extent of support given to this proposition. Focus of the research is not on general environmental analysis, but the existence of an unusual environment (high technology) provides the basis for expecting strategic planning and control system characteristics to be distinctive. The following proposition provides the context for hypotheses which appear in the next section.

Proposition 2: *Both quality of technology strategy content and suitability of the strategic planning and control system producing the strategy will influence both firms success and industry structure in high technology industries.*

If the environment is technologically driven, then strategies with high probability of succeeding in these environments should be technologically robust. Similarly, if appropriate strategies emerge from appropriate strategic planning and control systems (i.e., there would be few "lucky" strategies), then SPCSs come into focus as important factors in success. This overall view would find support among large numbers of researchers who argue for and evaluate "fit" between strategy (both process and content) and the environment (Venkatraman and Camillus, 1984; Venkatraman and Prescott, 1990), and perhaps those who emphasize "strategic intent" (e.g., Hamel and Prahalad, 1989), which may be designed to break or undermine an existing equilibrium within an industry.

Much of the tradition of strategic planning system research has differentiated planners from non-planners, formal planners from informal planners, etc. (Ramanujam, et al., 1986). These kinds of distinctions have not yet been proposed as bases for structuring an industry. However, a firm's approach to strategic planning and control tends to be a highly proprietary and idiosyncratic factor in competition, possessing measurable economic impact. The system is a tangible manifestation of management skill and process strategy. According, it should provide a sound basis for **strategic group formation** and qualify as a **mobility barrier** (McGee and Thomas, 1966).

C. RESEARCH HYPOTHESES

Five hypotheses of varying complexity are tested in this study in an attempt to expand knowledge in the strategy field. Diversity among the hypotheses springs in part from a decision to tap alternate information sources, a methodological strategy recommended by Harrigan (1983). Establishing a link between strategy content and process (Jemison, 1981), as well as between strategy and its environmental and performance consequences, also extends the range of hypotheses.

Hypothesis 1: *Technology strategy content variables dealing with (a) R&D intensity, (b) share of industry R&D, (c) patent rate, (d) change in patent rate, (e) reserve of patents, and (f) fixed asset newness will be positively correlated with economic performance among firms in a high technology industry.*

The literature reviewed and the theoretical foundation of this study presume an environment and a strategy where technology is a major factor. Were the chosen sample to show that technology strategy is inconsequential, generalization of results to true high technology settings might be questionable.

Hypothesis 2: *Strategic groups structure formed on the basis of technology strategy content variables (per H1) will account for a significant amount of economic performance variance within a high technology industry.*

Strategic group analysis effectively reduces the theoretical possibilities for technology in an industry to the practical reality of what actually is happening. In other words, strategic groups reveal **viable niches in strategy space** (Hatten and Hatten, 1987). The technology basis for strategic group formation becomes more interesting and managerially important to the extent that the structure help decode performance variations within the industry. Testing this hypothesis adds to knowledge about strategic difference revealed by H1, information about their possible economic consequences.

Hypothesis 3: *Among high technology firms, strategic planning and control system variables relating to (a) integrative ability, (b) risk accommodation, (c) technical*

knowledge focus, (d) organizational learning facilitation, (e) vision projection, and (f) corporate culture salience will be positively associated with economic performance and perceived system adequacy.

Survey research is employed to probe attributes of strategic planning and control systems now operating in high technology firms. Each variable is operationalized using multiple scales developed from the literature to provide a thorough characterization of current systems. This hypothesis should help to test whether strategic planning and control systems have recognizable economic benefits. It also should reveal the most valuable attributes of the system.

Hypothesis 4: *Strategic typologies on the basis of strategic planning and control system attribute variables (per H3) will account for significant variance in economic performance and perceived system adequacy among high technology firms from multiple industries.*

The same taxonomic approach used for strategic group analysis is employed in this phase of the study to structure **high technology strategy process space**. The multi-industry context should give rise to general process typologies that have broad application to high technology competition. Again, testing for performance differences reveals possible value differentials of competing types.

Hypothesis 5: *The strategic group structure for the computer industry implied by the high technology strategic planning and control system typology (as tested in H4) will be similar to the strategic group structure from technology strategy content (as tested in H2).*

If sound strategy is a product of well-designed strategic planning and control systems, then there should be a measurable coincidence of strategic group structures derived from strategy process and content bases. This hypothesis underscores the value of strategic planning and control systems and highlights their role as co-determinants of structure in the competitive environment.

An elaborated strategy model depicting each of the research hypotheses just described appears in Figure 2, on page 48. It is a direct extension of the industrial organization paradigm and the basic strategic planning and control framework for high technology firms referred to earlier.

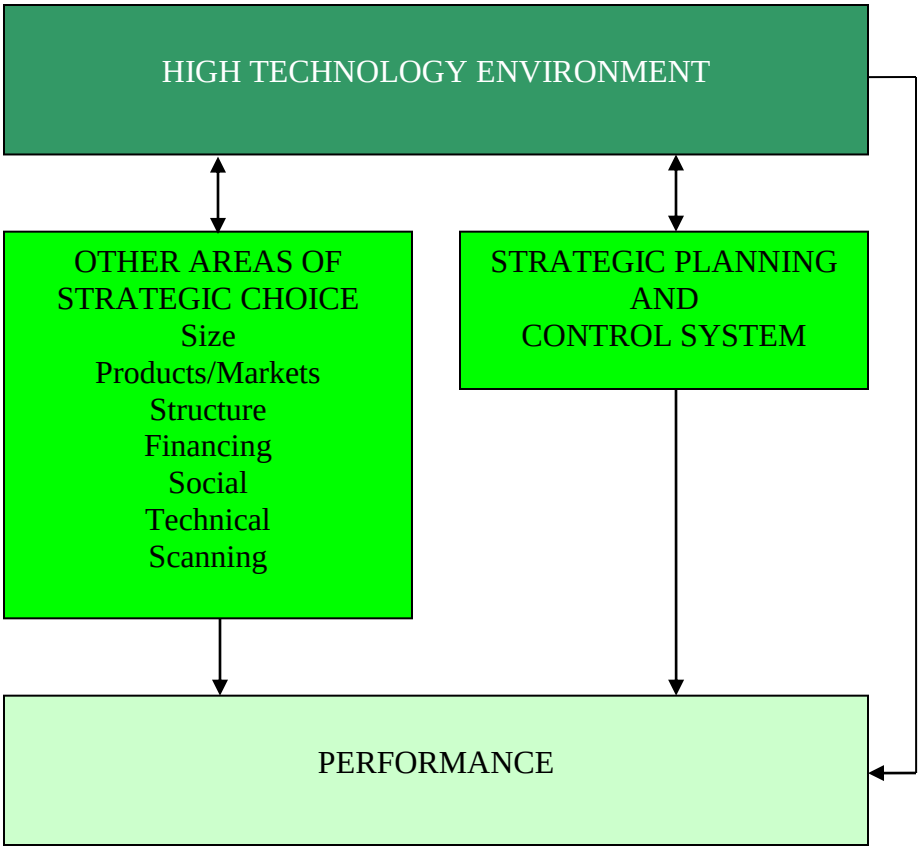

Figure 1

Strategic Planning and Control Framework for High Technology Firms

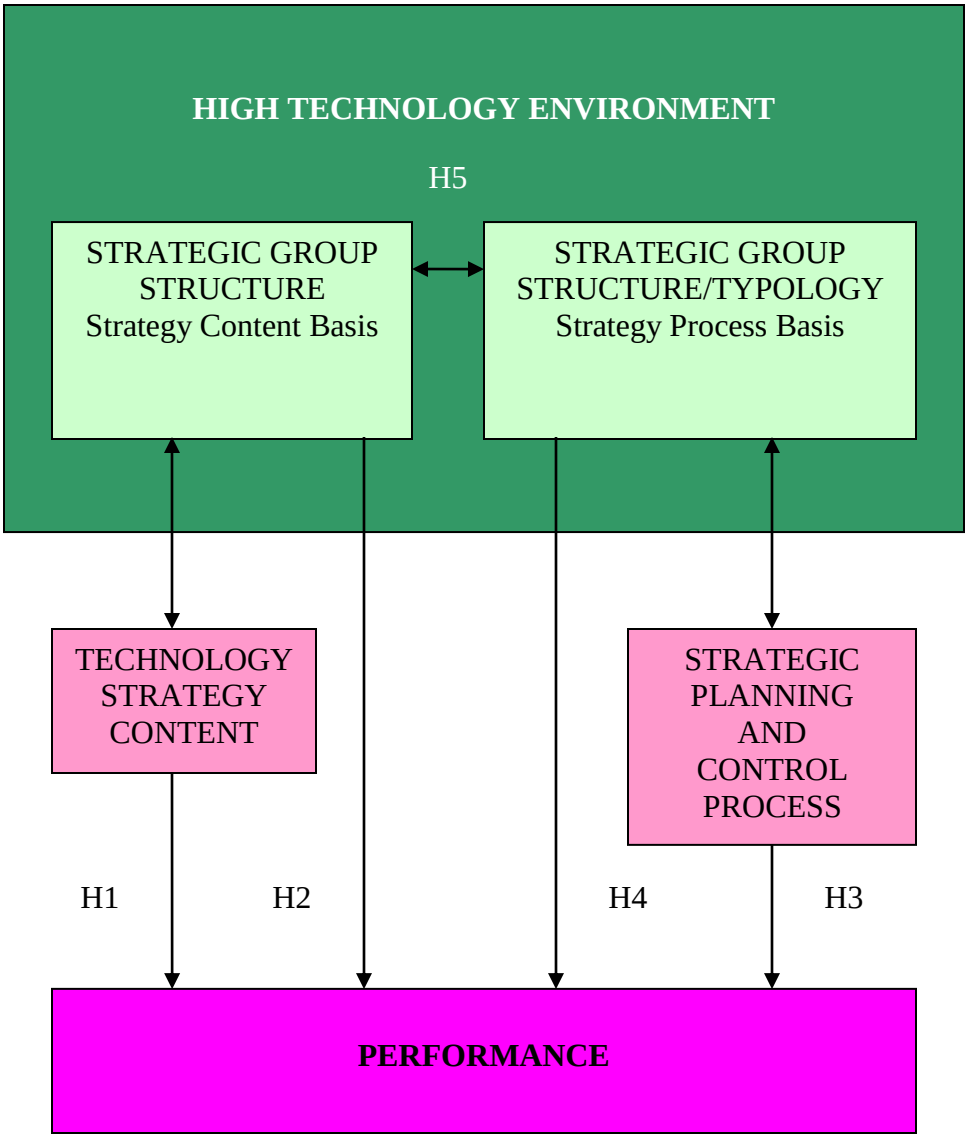

Figure 2

Elaborated Strategy Model Showing Research Hypotheses

Chapter IV
RESEARCH DESIGN

In this chapter, dimensions of the plan to address the research problem and test the five hypotheses proposed in the previous chapter will be elaborated. Issues of sampling, variable selection, and data analysis will be dealt with in considerable detail, since they fundamentally impact validity of the study.

A. TARGET POPULATION

Perspective Nu: In looking at the following criteria for identifying those lines of commerce that are high technology, it is interesting to consider a spiritual dimension to such categorization. Most noticeable is the prevalence of lightning-fast electromagnetic wave phenomena woven into the products (e.g., computing and telecommunications). These embrace a part of nature proceeding at the speed of light, the maximum velocity found in nature. Referenced by the constant, c, it registers at an amazing 186,000 miles per second (7 times around the world in one second!). Einstein's work in relativity contemplates speeds faster than light, but this creative mind from Jewry, God's Chosen People, and the only genius scientist ever offered presidency of a nation, intrinsically showed how reality collapses at hyper-light speeds. Biblical references to **God speed** are well-interpreted by modern understanding of light's speed, as God is referred to as *light* in the Holy Scripture, and is an unfailing constancy in and above creation. Other salient categories of high technology enterprise embrace human anatomy at its highest level of understanding yet (medical instruments, medicines). Biblically, we are regarded as fearfully and wonderfully made by God, His highest creation, a holy temple in which he has chosen to abide forever. In this light, high technology arising in the 20th Century is more than amazing industry, it is an endeavor of man touching the divine. We who research it should regard the matter as a sacred trust. Those who manage it, also bear responsibility for transcendent wisdom and incorruptability, thereby apt stewards of sacred nature.

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Perspective Nu.WMA

If there come any unto you, and bring not this doctrine, receive him not into your house, neither bid him God speed: For ***he that biddeth him God speed is partaker of his evil deeds****. 2 John:1.10-11 This then is the message which we have heard of him, and declare unto you, that* ***God is light****, and in him is no darkness at all. 1 John:1.5 What? Know ye not that* ***your body is the temple of the Holy Ghost*** *which is in you, which ye have of God, and* ***ye are not your own****? For ye are bought with a price:* ***therefore glorify God in your body, and in your spirit****, which are God's. 1 Corinthians:6.19-20*

The target population for this research is the expanding group of firms engaged in technology-intensive commerce. Both industry-based and product-based criteria have been used to define what is now popularly referred to as "high technology" enterprise, but there is not yet a consensus among researchers as to the definition of either "technology" or "high technology" (Souder and Shrivastava, 1985).

Boretsky (1982, 1971) defines **technological intensity** on an industry basis. He considered industry R&D expenditures as a percentage of value added and industry employment of scientists, engineers, and technicians as a percentage of total employment

in making technology-based classifications. High technology industries are distinguished by levels of 10% or higher for both indicators. As of 1982, the high technology group in the U.S. consisted of aerospace and missiles (Standard Industrial Classification 372 and 376); drugs and medicinals (SIC 283); electrical apparatus and equipment (SIC 36 excluding SIC 365-367); instruments and related products (SIC 38) office computing and accounting equipment (SIC 357); and radio, television, communications equipment, and electronic components (SIC 365-367). Industries registering at least 5% on the two indicators were considered technology intensive by Boretsky (1982). These industries included chemicals and related products (SIC 28); electrical and electronic equipment (SIC 36); instrument and related products (SIC 38); nonelectric machinery (SIC 35); and transportation equipment, missiles, and ordinance (SIC 37).

In a 1983 study of high technology industries conducted by the federal government, ten industries were regarded as constituting the high technology sector of the economy. These were: agricultural chemicals, aircraft and parts, computers and office equipment, drugs and medicines, electrical equipment and components, engines and turbines, industrial chemicals, optical and medical instruments, plastic and synthetic materials, and professional and scientific instruments (U.S. Department of Commerce, 1983). Over the 1970-1980 period, this group contributed significantly to the economy. Its real output growth was 7% versus 3% for all U.S. business. Average annual inflation over the period was 2.5% versus 7% for the economy as a whole. These industries contributed growing annual trade surpluses in the $5-$20 billion range while other-than-high-technology business experienced increasing trade deficits that grew into the $40-$50 billion range. Average annual productivity growth for the high technology sector was 5.6% versus a 0.9% growth rate for all business. While annual employment growth was 2.2% for all U.S. business, high technology and its support industries recorded an average employment growth rate of 3.4%. As of 1980, high technology exports comprised about 44% of total U.S. manufactures. More recent statistics on high technology industries indicate that trade balances are deteriorating and that international competition is dramatically intensifying (Hatter, 1985; Finan and Sandberg, 1986). In 1989, and again in 1991, for example, negative balances were recorded in U.S. computing equipment trade, and area of high technology activity with a previously strong tradition of U.S. dominance (U.S. Department of Commerce, 1992). Although policy initiatives by the federal government (such as the Exon-Florio amendment of 1988, the Critical Technologies initiatives overseen by the Congressional Subcommittee on Technology and Competitiveness, and federally-endorsed high technology consortia) are reducing the threat to some of these industries, the need for strategy research that will enhance competitiveness of the American high technology sector remains a priority (United States Congress, Senate Committee on Commerce, Science and Transportation, 1992; United States Congress, House Committee on Science, Space, and Technology, Subcommittee on Technology and Competitiveness, 1992; and United States Congress, Joint Economic Committee, 1989).

Although the industry approach to defining high technology commerce is most relevant to this research, a comment about the product-based approach is appropriate. It reveals a deficiency in the former as a result of the broad range of product offerings within a given industry. Some of the products within high technology industries are not technologically intensive. Kelly (1977) proposes a classification scheme based on **product technological intensity** as measured by applied product R&D expenditures divided by product shipment value. Products with above-average **R&D intensity** are regarded as high technology. According to this criterion, 31 product types differentiated by their Standard International Trade Classification codes fall into the high technology category.

B. RESEARCH SAMPLE

Three industries classified by the Department of Commerce (1983) as high technology comprised the research sample for this study. The U.S. computer industry defined by firms with primary SIC code 357, computer and office equipment, forms the cornerstone of the sample inasmuch as it is included in both primary data and secondary data subsamples. In order to accommodate the sample size attrition resulting from the use of mail survey methods, the primary data sample was expanded to include firms from SIC 36 (electric and other electrical equipment and components, except computer equipment) and SIC 38 (measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks). However, firms within SIC 387 (watches, clocks, clockwork operated devices, and parts) were excluded because their products are not as clearly high tech as the others. These supplemental classifications were chosen from among the full array of high technology candidates on the basis of close relationship to the computer industry, inasmuch as both rely heavily upon electronics technology.

1. Database Subsample

Among the high technology candidates that could be chosen, the computer industry appears to occupy a prominent position. It is led by firms such as International Business Machines Corporation, UNISYS Corporation, Digital Equipment Corporation, Hewlett-Packard Company, NCR Corporation (now part of AT&T), and Control Data Corporation. These are multinational enterprises with distinguished reputations for innovation. The products produced by this industry are being utilized globally in almost every major area of business activity to raise productivity, improve quality, and eliminate tedius work. The computer is helping to transform modern industrial society into an information society, marking one of the most significant recent societal transitions (Naisbitt, 1982).

To focus on firms having relatively well-defined planning and control systems, small businesses were excluded from the sample. Examining medium and large firms also focuses the study where problems of direction and coordination are greater. According to

Siropolis (1986) computer manufacturers employing less than 1,000 people are classified as small businesses by the Small Business Administration.

The sample used for extraction of secondary data included manufacturers of computer systems, peripheral equipment, and other office machines. There were 46 firms classified under SIC 357 by the Compustat II database (Standard & Poor's Compustat Services, Inc.) that employ 1,000 or more employees. These constituted the secondary data subsample.

2. Survey Subsample

The portion of the study employing primary data utilized a broader sample specification in order to assure an adequate mail survey response for statistical analysis. Restrictions on firm size applied to the database subsample were maintained. All of the 46 firms included in the primary data subsample were included in the survey subsample. An additional 29 firms drawn from the Compact Disclosure database (Disclosure, Incorporated) which fit the sampling specification also were surveyed, bringing the total sample from SIC 357 to 75 firms. There were 109 firms in the survey sample from SIC major group 36. Finally, a total of 53 firms from SIC major group 38 completed the survey sample. The grand total of firms in the survey subsample was 237.

Questionnaires were directed to senior management in the surveyed organizations. In most cases, the firm's president as reported by Compact Disclosure was the contact. For larger organizations, an attempt was made to identify managers of strategic planning, or those with similar responsibilities, on the basis of titles listed in the 1991 Corporate 1,000 Yellow Book (Monitor Publishing Company), and to contact them directly.

3. Pilot Sample

Prior to conducting the survey of high technology firms classified under SIC 357, SIC 36, and SIC 38, the survey instrument was pilot-tested among several firms in the Pittsburgh, Pennsylvania area. A pre-pilot review involving Aluminum Company of America, Miles Incorporated, and Westinghouse Electric Corporation in August 1991 helped to refine wording and focus of the instrument. The pilot evaluation involved member firms of the Pittsburgh High Technology Council and was conducted in October 1991. Questionnaires were mailed to the presidents of 18 firms employing 250 or more that exhibited a high technology orientation to their business activities. Responses were received from eight: Calgon Carbon Corporation, Contraves U.S.A., Dynamex Incorporated, Elliot Company, Medrad Incorporated, Mine Safety Appliances Company, and Robicon Corporation. Although this sample was too small for meaningful statistical analysis, it did give some indications that the instrument was reliable and free of significant omissions or ambiguities.

4. Unit of Analysis

Individual firms competing in the U.S. computer industry from a North American base constituted the unit of analysis for the initial phase of this study. Technically, the unit of analysis for perceptual data gathered was the strategic planning and control system operating in each high technology firm. Since the system under investigation was expected to be firm-wide, and there were few multidivisional organizations with extensive low-technology operations, this presented no major conceptual or operational problem.

5. Time Frame for Analysis

All of the secondary data used in the study were drawn from the 1985-1989 period. This time-frame excludes the deep recession years of the early 1980s as well as the recessionary period which began in 1990. Patent data extended back to 1974 to capture longer-term history. Perceptual data were collected in the first quarter of 1992, but reflect strategic planning and control system operation over the previous five years. Questionnaires were mailed January 15, 1992. Follow-up letters to non-respondents were sent February 12, 1992. Telephone follow-up of remaining non-respondents was conducted March 10-13, 1992.

C. OPERATIONALIZATION OF RESEARCH CONSTRUCTS

1. Technology Strategy Content

Technology strategy content was operationalized broadly, but not comprehensively. This is in keeping with the purpose of evaluating sample representativeness by establishing whether or not technology significantly impacts strategy and performance in this industry. Firm **R&D Intensity** (R&D expenditures/total revenue, expressed as a percentage) is a very prominent operationalization of technology strategy in strategic studies (Tassey, 1983; Hambrick et al., 1983; Hambrick and MacMillan, 1985; Horwitch and Thietart, 1987). R&D is a business expense which must compete with other sources of selling and administrative expense for the firm's funds. It also is highly discretionary in that budget cuts have minimal adverse short-term effect and cutting R&D is a tempting remedy for a firm facing cash flow problems. Firms committed to building **distinct technological competencies** will reflect their commitment by high R&D Intensity. In this study, R&D Intensity (assigned the acronym R&DINT) was averaged over the 1985-1989 period.

A technological corollary to "market share", **R&D Share** (firm R&D expenditure/industry R&D expenditure, expressed as a percentage) was used as a strategic variable. If technology is the basis for competitive advantage in this (or any) industry, then firms that choose to have a relatively larger share in its development

should improve the probability of securing greater competitive advantage and being better performers. Again, this variable (assigned the acronym R&DSHR) was averaged over the 1985-1989 period.

Patent activity is another factor that figures prominently in technology strategy (Griliches, 1984). **Patent Rate** (average number of patents granted annually) is one indicator of a firm's ability to generate proprietary technology that is widely used. It was averaged over the 1985-1989 period and assigned the acronym PATRATE. This was supplemented by a **Patent Reserve** variable (total number of patents granted 1974-1989), which was given the acronym PATRES. Both recognize the contribution of proprietary technology to competitive advantage. The latter variable should portray the benefit of a long-term commitment to technology, as well as the long-term benefits of proprietary technology. By combining the previous patent variables, a relative measure of patent activity was defined and employed. Designated **Patent Index** (and assigned the acronym PATINDX), it is the ratio of the 1985-1989 average patent rate to the historical average rate over the 1974-1989 period. This reveals if **invention productivity** is on the rise or falling, regardless of absolute levels.

Technology strategy also influences capital budgeting. It is likely that firms committed to the leading edge of manufacturing technology will renew their plant and equipment more frequently than less innovative firms. The extreme of the latter case would be firms that think they will realize maximum economic benefit from their capital expenditures by running plant and equipment to a fully depreciated state. Accordingly, **Age of Fixed Assets** (undepreciated fixed assets/annual capital expenditures averaged over the 1985-1989 period) served as another indicator of technology strategy. It was assigned the acronym AGE.

2. Strategic Planning and Control System (SPCS)

High technology organizations were surveyed using a structured questionnaire in order to gather data on their strategic planning and control systems. Six summated rating subscales with 7-point, interval scaling were used to operationalize SPCS variables: (1) integrative ability, (2) risk accommodation, (3) technical knowledge focus, (4) organizational learning facilitation, (5) vision projection, and (6) corporate culture salience (see complete example of survey instrument in Appendix A). In the vast majority of cases, the questionnaires were sent to company presidents. For larger firms, executives with titles indicating strategic planning staff responsibilities in the 1991 Corporate 1,000 Yellow book (Monitor Publishing Company, New York) were contacted.

3. Performance

In a study of excellent companies from the computer industry, Chakravarthy (1987) concludes that diverse measures of performance are necessary to portray excellence. Although the definition of excellence is itself arguable, few strategy researchers would dispute the admonition to operationalize performance diversely in order to capture an adequate set of its many dimensions.

Six different operationalizations of performance based on 1985-1989 averages were employed in the database research. **Absolute Profit Growth** was measured by average net income change in millions of dollars (NICHG). It conveys a sense of whether the economic fortunes of a firm are expanding or contracting. **Relative Profitability** was indicated by percentage return on sales (ROS). This is the margin of net profit earned with each sales transaction. **Relative Asset Efficiency** was indicated by percentage return on assets (ROA). This also is calculated by the product of *margin of net profit* times *asset turnover*, and it reveals how efficiently management is utilizing the firm's assets. **Shareholder Return** was indicated by total, unadjusted returns to common stockholders expressed as a percentage (STKRET). This measure reflects the degree to which the firm serves its shareholders. Both absolute and relative measures of sales growth were included in the performance set. Absolute sales growth in millions of dollars over the 1985-1989 period (SLSCHG) was used to measure **Absolute Potential Realization** within the industry. The average annual percent change in sales over the 1985-1989 period (SLSCHG%) was use to measure **Relative Potential Realization**.

A separate set of performance measure was employed in connection with the survey research effort (see Appendix A for questionnaire). Respondents were asked to indicate their perception of **SPCS Effectiveness, Firm Financial Performance, Stock Price Performance,** and **Satisfaction with the Firm's SPCS** on a seven-point scale.

The choice not to design the survey research around the same performance variable set chosen for the database study requires some explanation. The database study dealt with a single, relatively homogeneous industry group (SIC 357). In it were only seven 4-digit industries. By contrast, the survey encompassed 15 industry groups containing sixty 4-digit industries. Traditional methods for removing this bias, involving the calculation of *industry correction factors,* are frustrated when the sample is as small and diverse as this. Perceptual assessments of performance, however, eliminate this industry effect. Each respondent tends to assess his or her firm's performance with respect to close competitors in the industry, or even in the firm's strategic group.

An additional performance-related issue was addressed by a descriptive variable in the survey instrument. The literature review disclosed that *nonfinancial control variables* are being used by firms exploiting advanced manufacturing techniques. Although this aspect of technology was not the basis for selection of high technology firms included in either

subsample of this study, whether or not these firms are using nonfinancial performance criteria to an appreciable degree is an intriguing question. Accordingly, **Usage of Nonfinancial Measures** was assessed on a single, 7-point scale in the survey.

D. DATA ANALYSIS METHODS

Perspective Xi: The test for normality is widest used in statistical analysis. The normal curve dominates the physical and social worlds, and can be considered a signature of God. It is His way of building forgiveness into perfect creation, His standard for error in an otherwise perfect world. Interesting is the grace given mean behavior. He has set man over a marvelous creation, with those *average* ruling in greater numbers than those at the extremes. We in research extol intelligence. Those in athletics extol size and strength. Yet it is the nominal among us upon which God bestows his greater love by its numerical advantage in paradise.

Methodology herein gives highest regard to tests for normality, but also invests in distribution-free testing as a back-up. Usually, non-parametric tests are invoked only when sample size is small, below the threshold for expression of normal behavior. While this is a general caveat in studying the small, high-tech domain of American or global business, liberal use of distribution-free testing along with parametrics in the statistical array qualifies as a forward step of this dissertation research. Another novelty is projecting a *norm* for strategic group (medium-grained) subdivision of an industry. Setting the square root of n as structural normalcy in an n-firm industry has some empirical support, but is otherwise inspirational. I cling to this level of abstraction or taxonomic reduction of industry phenomena with faith that increasingly complicated and populated industries will remain tractable for study. Our minds and methods struggle at full dimensionality, but remain within the grasp of truth at the simplest root of its expression. Factor analysis, a contributing element to strategic group mapping, proceeds on much the same faith basis in reducing voluminous data to a core of variability and understandability.

William C. Patterson Ph.D.

Perspective Xi.WMA

***Unto you it is given to know the mystery of the kingdom of God**: but unto them that are without, all these things are done in parables: That seeing they may see, and not perceive; and hearing they may hear, and not understand; lest at any time they should be converted, and their sins should be forgiven them. Mark:4.11-12*
***Many prophets and righteous men have desired to see those things which ye see**, and have not seen them; and to hear those things which ye hear, and have not heard them. Matthew:13.17*

The empirical portion of this research is fundamentally a correlational research design with some elements of descriptive research (Isaac and Michael, 1981). Accordingly, research methodology is primarily quantitative, although some qualitative techniques are used, as well (Miles and Huberman, 1987; Miller,1983). Engaging both quantitative and qualitative methodology is a form of triangulation (Jick, 1979). It makes the design holistic in the sense that phenomena not captured by the formal, quantitative model can be factored into the study to enrich and expand understanding.

The linkage between strategy process/content variables and performance addressed in hypotheses 1 and 3 was assessed via correlation analysis and regression analysis.

Explanatory capability of the independent variable set was measured by adjusted coefficients of determination. Regression coefficients are not reported due to problems with multicollinearity. Significant zero-order correlations provide the basis for inferring causality. Both Pearson correlation coefficient and Spearman correlation coefficients were evaluated in the database portion of the study. The latter was invoked to be sure that distributional assumptions were not yielding erroneous results (both SLSCHG and NICHG data displayed marked departure from normality).

Examination of industry structure was based on strategic group theory and used the statistical methodology which has evolved in that domain (see Harrigan, 1985). Specifically, a cluster analytic approach of the type introduced by Hatten (1974) was used to form strategic groups in the computer industry. The technique is somewhat imprecise and judgmental. Accordingly, there is some methodological discretion left to the researcher. For this study, the K-means algorithm was employed to minimize within-cluster sum of squares of standardized independent variables (Hartigan, 1975). The total number of clusters was chosen on the basis of two criteria. First, attention focused on cluster arrays which appear to sharply reduce within-cluster sum of squares and for which the within-cluster sum of squares was not materially reduced by increasing the number of clusters further. Also, clustering variables were evaluated for significant between-cluster differences using analysis of variance (ANOVA) and Kruskal-Wallace' multisample test, the latter to provide a check on parametric assumptions. Ideally, all variables should be differentiated in the associated F and Chi-square tests, and a relatively simple strategic group structure should result. What constitutes "**simple structure**" is not very exact. The range lies somewhere between one strategic group and n strategic groups for an industry with n firms. When strategies are not particularly diverse, less than 10 strategic groups usually are adequate to represent extant strategy. Examination of a few recent studies suggests that simple structure is achieved at about $n^{1/2}$ (see Cool and Schendel, 1988; Harrigan, 1985; Dess and Davis, 1984).

Hypothesis 2 deals with the industry structure-performance linkage. It was evaluated using ANOVA and Kruskal-Wallis' multisample test, the latter to provide a check on parametric assumptions. Performance differences attributable to strategic membership are the bases for accepting this hypothesis. Further testing of performance differences among groups via pair-wise comparisons employed Scheffe's procedure and Conover's procedure.

Hypothesis 4 deals with the relationship between dominant SPCS types and performance. It was evaluated using ANOVA, without confirmation by parallel nonparametric tests, because all data are uniformly scaled and approximately normal in distribution. Performance differences attributable to SPCS type provide the basis for accepting this hypothesis. Further testing of performance differences among types via pair-wise comparisons was conducted using Scheffe's procedure.

Testing hypothesis 5 required measuring the similarity between strategic group structures produced from different bases. Although Sadhu and Prescott (1986), Cool (1985), and Ryans and Winnink (1982) examined various ways of making strategic group comparisons, the method used here appears to offer greater simplicity than earlier techniques. It involves comparing resemblance matrices of dissimilarity coefficients for the two different group structures via simple correlation analysis. The degree and significance of resemblance matrix correlation provides the basis for accepting/rejecting an hypothesis of similarity.

Because there was a relatively small number of computer industry (SIC 357) firms that participated in the survey who also were included in the Compustat database, no effort was made to explicitly develop a parallel strategic group structure based upon strategy process factors (SPCS attributes). However, the methodology used to construct the multi-industry SPCS typology faithfully reproduces the same arrangement of this subset of firms in Euclidean space that would have prevailed in a strategic group analysis involving more computer industry members.

Although this study is primarily hypothetico-deductive, analysis was extended beyond that needed to test specific hypotheses. The ultimate goal was to capture the knowledge revealed by hypothesis testing and related data collection and analyses graphically.

Strategy maps are a form of comprehensive knowledge representation beginning to receive more attention in strategy research. Ryans and Wittink (1985) employed factor analysis to generate strategic group maps in the airline industry. Day et al. (1987) used multidimensional scaling to spatially represent competitive strategy and performance variables within another, unspecified industry drawn from the Profit Impact of Marketing Strategy (PIMS) database. Adaptations of these techniques employing a factor analytic approach augment this research.

Strategy maps were constructed by first simultaneously factor analyzing standardized criterion and predictor variables to achieve dimensional reduction. Factor retention was based upon eigenvalue cutoff of one. Varimax-rotated factor loadings were plotted in what often is called a factor pattern plot. This produced a graph similar to that achieved with the multidimensional scaling approach mentioned previously, and accomplishes essentially the same result of revealing strategy/performance tradeoffs spatially. It is helpful to visualize the pattern plots in terms of radial vectors whose magnitude and direction indicate the strength of the original variables' association with one another in the new coordinate system.

Strategic group maps also were constructed on the basis of a factor analytic technique. Here, the full array of standardized strategy variables was factor analyzed to reduce dimensionality. Again, factor retention was based upon an eigenvalue cutoff on one, and Varimax rotation was employed. Factor scores coded by strategic groups identity were

plotted in two dimensions using all combinations of retained factors. This depicts strategic group positioning in dimensionally-reduced space, which can be regarded as **strategy space**.

Statistical assessment of the survey variable dealing with use of nonfinancial performance measures for control in high technology SPCSs (indicant 59) was on the basis of mean response. Evaluation contingent upon evidence of appreciable use of nonfinancial measures involved correlation analysis to assess complementarity with the independent SPCS attribute variable and causal connection to dependent performance variables.

E. RELIABILITY AND VALIDITY

Reliability of subscales in the questionnaire (Appendix A) was assessed by the widely-used coefficient alpha proposed by Cronbach (1951). Results appear in Table 2, on page 62. Values range from a low of 0.74 for the Vision Projection subscale to a high of 0.89 for the Corporate Culture Salience subscale. Since reliability is considered good for alphas in the vicinity of 0.8 or above, this instrument can be considered reliable.

The issue of research validity is much broader. Mitchell (1985) recommends addressing internal validity, construct validity, external validity, and statistical conclusion validity when conducting correlational research on organizations. Kerlinger (1986) encourages assessment of content validity, criterion-related validity, as well as construct validity.

The issue of internal validity has to do with whether or not the independent variables indeed influence the dependent variable. It is particularly relevant to consider the possibility of spurious causal factors. Huck and Sandler (1979) refer to these as *rival hypotheses*. Thus, potentially competing explanations for the relationship between strategy process/content and performance variables established by this research must be ruled out.

The most significant rival hypothesis for the strategy content-performance relationship centers on the issue of reverse causality. Might it be that only successful firms in the computer industry can afford the luxury or expense of R&D, patenting, and accelerated facility renewal, and that other, correlated choices or activities really underpin their success? Such a generalization does not survive a test of conventional logic, although it may explain a few examples. The capital committed to technology in this industry is extremely high relative to industry in general. It is unlikely that this heightened level of commitment would be maintained so broadly and persistently if expenditures in these areas were not generally necessary and effectual.

A potential rival hypothesis for the strategy process-performance relationship is that what has been characterized as a SPCS is nothing more than “good management practice.” To

a degree, this cannot be refuted. First, design and operation of a system for planning and control is a management responsibility and appropriately falls within the broad domain of management. Secondly, many system variables (i.e., indicants making up the scales) are not customarily associated with a "formal" SPCS. This research has broadened the concept of a system to include both formal and informal elements because less formalism in high technology strategic planning and control systems was expected. However, actions taken systematically, that is, with repetition or as acknowledged policy, can be defended as SPCS elements. Their stable associations with the decision making that produces strategy for high technology firms makes them legitimate, albeit "semi-formal," system components.

Statistical conclusion validity really is an aspect of internal validity and relates to the stability of results due to sampling procedures. In this study, both subsample sizes exceeded the threshold for large sample behavior ($n>29$), and therefore should promote stable results. Also, the confirmation of reliability and judicious selection and application of statistical tests guard against problems with statistical conclusion validity. Specific remedies to emergent statistical problems included use of nonparametric techniques to handle ill-conditioned data, design remedies to eliminate industry bias, and tests for mean differences to assess nonresponse bias.

External validity has to do with generalizability of results. Because high technology industries have not been the focus of a great deal of research, their homogeneity regarding strategic management remains to be established. Accordingly, results of this study should be only tentatively applied to high technology industries outside of those sampled.

Validation of the six constructs measured by the questionnaire is based on item analysis. Item-total correlations appearing in Table 2 give consistent statistical support for the construct validity of each subscale in all but 4 of the 54 assessments.

Kerlinger (1986) states that content validation usually is determined judgmentally on the basis of how representative an instrument is of the universe being measured. In this study, questionnaire content was drawn from rather comprehensive reviews of four relevant literature domains. To the extent that the collective expertise of the researchers cited has been brought to bear on the subject matter of this instrument, its content validity should be rather high. The lack of amplifying or supplemental comments invited from respondents on the questionnaire also affirms content validity.

Criterion-related validity has to do with comparing scale scores with external variables thought to associate with the attribute(s) being studied. The expectation of this study is that the identified SPCS attributes should positively correlate with various measures of organizational performance. The extensive record of such correlations involving the four

performance measures adopted for this study (see Table 7, page 78) suggests that this aspect of validity, also known as *predictive validity*, is adequate.

Perspective Omicron: Noticeably missing in tests for validity of research work is validity of the researcher, himself. Some might say this is intrinsic, as those of the doctoral fraternity faithfully oversee the quality of work and truth produced from their process. That body regards the tests followed in this study to meet their fraternal approval. Yet to qualify in research validity is some consideration of the investigator's approval by God. Benefits of this validation are significant, as we know that God is **truth**, His **knowledge** and **wisdom** above man's, and His reach to facts **unlimited by time**. So central is God's endorsement of a man and his work, that I regard it irresponsible to grant higher education to any until they clearly know the Almighty, and are capable of faithful obedience in wielding the power of higher knowledge. Person validation also eases society's burden of investing in a man's creative work. At the Ph.D. level, few in the world know and understand what one such man knows. Few can resist claims from such a knowledge fraternity, and are defenseless if their counsel is wrong or misguided. Better it is to know that God approves a man. Then, what he says needs less to be checked out by the vulnerable, and less *caveat emptor*. Avoided are moral error (ungodliness, unrighteousness, ignorance), misrepresentation (theft of another's intellectual property), manipulation (propagandizing), or abuse of power (self-serving, greed).

William C. Patterson Ph.D.

Perspective Omicron.WMA

Blessed is the man that walketh not in the counsel of the ungodly, nor standeth in the way of sinners, nor sitteth in the seat of the scornful. But his delight is in the law of the LORD; and in his law doth he meditate day and night. And he shall be like a tree planted by the rivers of water, that bringeth forth his fruit in his season; his leaf also shall not wither; and ***whatsoever he doeth shall prosper****. Psalm:1.1-3 And if it seem evil unto you to serve the LORD, choose you this day whom ye will serve; whether the gods which your fathers served that were on the other side of the flood, or the gods of the Amorites, in whose land ye dwell: but* ***as for me and my house, we will serve the LORD****. Joshua:24.15*

TABLE 2

Strategic Planning and Control System Survey Instrument Diagnostics

Subscale	Integrative Capability		Risk Accommodation		Technical Knowledge Focus	
Chronbach alpha	0.77		0.88		0.81	
Indicant Number and Correlations	1	*0.26*	14	0.50	26	0.78
	2	*-0.05*	15	0.68	27	0.69
	3	0.66	16	0.58	28	0.44
	4	0.55	17	0.68	29	0.50
	5	0.49	18	0.70	30	0.69
	6	0.67	19	0.80	31	0.69
	7	0.71	20	0.83	32	0.74
	8	0.49	21	*0.29*	33	0.67
	9	0.34	22	0.54		
	10	0.73	23	0.76		
	11	0.71	24	0.82		
	12	0.57	25	0.82		
	13	0.64				
Subscale	**Organizational Learning Enhancement**		**Vision Projection**		**Corporate Culture Salience**	
Chronbach alpha	0.87		0.74		0.89	
Indicant Correlations	34	0.58	45	0.80	50	0.80
	35	0.79	46	0.60	51	0.85
	36	0.81	47	0.58	52	0.88
	37	0.65	48	0.75	53	0.88
	38	0.73	49	0.78	54	0.73
	39	*0.32*				
	40	0.73				
	41	0.52				
	42	0.60				
	43	0.75				
	44	0.71				

NOTE: All correlation coefficients significant at $p<0.05$ except those in italics.

Chapter V
RESULTS OF ANALYSES

In this chapter, analyses of both primary and secondary data subsamples will be discussed. Descriptive statistical information will be given on each sample, and the results of inferential statistical analyses used to test the five hypotheses will be reviewed. The outcome of mapping procedures intended to augment hypothetical knowledge and render a more holistic view of results also will be described.

A. DATABASE RESEARCH

The first two hypotheses were tested using data drawn from the Compustat II database. They assess the technology strategy-performance linkage and the industry structure-performance linkage. Descriptive statistics along with results pertaining to each of the aforementioned linkages are presented in the following sections.

1. Descriptive Statistics

Average employment among the 46 firms drawn from the Compustat II database was 22,510. The sample standard deviation in employment is 60,317. These statistics are strongly affected by a single firm in the sample: IBM. Extracting the effect of its employment level of 383,220 lowers the sample mean and standard deviation to 14,494 and 26, 421, respectively.

Average levels recorded for each of the technology strategy content variables employed, along with sample standard deviations (in parenthesis) are (R&DINT 7.52% (3.98%), R&DSHR 2.17% (7.13%), PATRATE 27.7 (95), PATRES 509 (1914), PATINDX 2.29 (1.37), and AGE 5.52 years (2.8 years).

2. Technology Strategy Content-Performance Linkage

Relationships between the six technology strategy content variables and each of the six performance variables derived from regression analysis and correlation analysis are presented in Table 3, found on page 74. The technology strategy variable set explains significant variance for all performance variables, except STKRET. All of the technology strategy variables exhibit predictive capability on the basis of correlation coefficients, except R&DINT. Variables R&DSHR, PATRATE, and PATRES are moderately-to-highly correlated with SLSCHANGE, while PATINDX and AGE are moderately-to-highly correlated with SLSCHG%.

The Pearson correlation coefficients for the significant NICHG predictors are counterintuitive on the basis of results with SLSCHG predictors. Examination of the

relationship between NICHG and SLSCHG for the firms in the sample revealed a discernible, but discontinuous function. When only firms posting positive NICHG were considered, NICHG and SLSCHG exhibited high positive correlation. The exact opposite relationship was observed when only firms posting negative NICHG were considered. The latter involves few firms, notably IBM UNISYS, and Wang, but the magnitudes recorded are large enough to completely reverse the overall correlation between NICHG and SLSCHG. For this reason, the correlation results between NICHG and its significant predictors (R&DSHR, PATRATE, and PATRES) should be regarded as atypical.

AGE exhibits moderate negative correlation with ROS, ROA, and STKRET. PATINDX displays low correlation with ROA and moderate correlation with STKRET.

The previous evidence suggests existence of a causal link between technology strategy and performance that is strong enough to confirm hypothesis 1.

Strategy maps spatially illustrating the various tradeoffs among technology strategy content variables and performance variables are presented in Figures 3 through 5, beginning on page 82. Three views are necessary because strategy space was not reducible to less than 3 dimensions. Although a single hologram or physical model might be even more desirable, this representation offers greater simplicity and imagery than the originating 12 x 12 correlation matrix involving nearly 70 distinct comparisons. Again, the results shown for NICHG should be regarded as atypical.

Positioning of lines (letters were used in the original thesis publication) in each two-dimensional view can be visualized as termination points of radial vectors whose magnitudes and directions reflect degrees of association among predictor and criterion variables. Comparisons among the three views reveal a desirable alignment of long predictor and criterion vectors of STKRET and R&DINT, and no lengthy predictor vectors for ROS and ROA.

3. Technology Strategy Content-Industry Structure Linkage

Traditionally, industry structure is regarded as a prime determinant of strategy. However, research involving strategic groups has shown that the reverse causal relationship also exists. Strategy drives industry structure primarily through the erection of mobility barriers between strategic groups. Table 4, on page 75, identifies the constituency of six strategic groups found in the computer industry using the statistical methodology previously described. Table 5, on page 76, depicts the technology strategy differences among groups, and indirectly reveals the mobility barriers present.

The following summary of Table 5 is based upon relative assessment of results ranging from very low to very high. Strategic Group 1 is characterized by high R&DSHR,

PATRATE, and PATRES; moderate R&DINT; low-to-moderate AGE; and low PATINDX. It contains firms with a long tradition of success in the computer industry, such as Data General, Digital Equipment Corporation, Hewlett-Packard, and NCR. Group 2 is distinguished by high PATINDX; low R&DINT; and very low R&DSHR, PATRATE, PATRES, and AGE. It contains some of the newer, fast-growing firms like Apple Computer and Compaq. Group 3 exhibits very high AGE; low R&DINT and PATINDX; very low R&DSHR, PATRATE, and PATRES. It has a diverse array of members. Group 4 displays very high R&DINT; high PATINDX; low R&DSHR; and very low PATRATE, PATRES, and AGE. It contains several niche players like Cray Research, Silicon Graphics, Sun Microsystems, and Tandem computers who specialize in supercomputers, workstations, and fault-tolerant computers. Group 5's strategy configuration involves low PATRATE, PATRES, PATINDX, and AGE with very low R&DINT and R&DSHR. Prominent in that group are desktop computer manufacturers like AST Research, Dell Computer, and Tandy. Group 6 consists of industry leader IBM and is characterized by very high R&DSHR, PATRATE, and PATRES; moderate-to-high AGE; moderate R&DINT; ad low PATINDX.

The strategic group map appearing in Figure7 on page 85 presents a somewhat clearer picture of the strategic group structure in the computer industry than the preceding prose descriptions. Loading on factor 1 were R&DSHR (0.98), PATRATE (0.99), and PATRES (0.98). Loading on factor 2, were R&DINT (-0.55), PATINDX (-0.80), and AGE (0.83). Positioning of individual firms in strategy space is indicated by keyed symbols (numbers were used in the original thesis publication) which also identify the strategy group to which each firm belongs. In order to capture the highly distinctive strategic positioning of IBM (Strategic Group 6), the lower portion of the strategic group map became severely compressed. This makes the map appear a bit busier, and groupings less differentiated, than otherwise would be the case.

Strategic Groups 2 and 4 primarily are associated with high negative levels of factor 2 (high R&DINT, high PATINDX, low AGE). Strategic Groups 3 and 5 primarily associate with high positive levels of the same factor. Groups 1 and 6 primarily associate with positive levels of factor 1 (high R&DSHR, high PATRATE, high PATRES).

4. The Industry Structure-Performance Linkage

Performance levels achieved as a result of the strategy configurations adopted by the six strategic groups in the computer industry are portrayed in Table 6, on page 77. The following description of results from Table 6 is based upon relative assessments ranging from very low to very high.

Strategic Group 1 is characterized by high SLSCHG; moderate ROA; low SLSCHG%, NICHG (actually negative), and ROS; and very low (negative) STKRET. Group 2 is distinguished by very high NICHG, ROA, and STKRET; high SLSCHG% and ROS; and

moderate SLSCHG. Group 3 exhibits moderate NICHG (actually 0); low STKRET (negative); and very low SLSCHG, SLSCHG%, ROS (actually negative), and ROA (actually negative). Group 4 displays very high SLSCHG%, ROA, and STKRET; high NICHG, and ROS; and low SLSCHG. Group 5 achieved very high ROA, high ROS, moderate-to-high NICHG, moderate SLSCHG%, low SLSCHG, and very low STKRET (actually negative). Finally, Group 6, consisting only of IBM, attained very high SLSCHG, ROS, and ROA; and very low SLSCHG%, NICHG (actually negative, and STKRET (actually negative).

Within the performance set, only SLSCHG and SLSCHG% register as strong differentiators among strategic groups based on significance tests in ANOVA and multiple comparisons. This suggests that extant technology strategy has as its main competitive impact the extension of both absolute and relative sales. It appears to have less to do with profitability capitalizing on the realized opportunity.

Overall, the results from Table 6 indicate that Strategic Groups 2 and 4 are performance leaders in the computer industry; Groups 1, 5, and 6 are mid-range performers; and Group 3 contains the least successful firms. Common, distinctive strategies among the two most successful strategic groups include high PATINDX and very low AGE. Additionally, Strategic Group 4 is configured for very high R&DINT. The least successful strategies, based upon results from Strategic Group 3, entail either very low or low settings for R&D and patent-related variables, plus a very high setting for AGE.

The evidence of a causal relationship between the strategic group structure (produced by technology strategy) and economic performance that emerges from the results in Table 6 and the previous discussion is considered substantial enough to accept hypothesis 2.

B. SURVEY RESEARCH

1. Descriptive Statistics

Of the 237 questionnaires mailed to high technology firms of medium and large size classified under SIC 357, SIC 36, and SIC 38, 10 were undeliverable. Responses were received from 46 firms, but only 34 returned usable questionnaires. This produced a net response rate of 15%. The rather low level of response is attributed partly to the choice of company presidents as addressees on most of the questionnaires. Rates of usable returns in the 10%-to-20% range are not uncommon in surveys targeting individual top executives (see Greer and Ireland, 1992; Hall, 1992; Hoskisson and Hitt, 1988; and Robinson and Pearce, 1988). In the feedback from this survey, many presidents directly or indirectly indicated that they simply did not have the time to devote to participation in studies of this nature. Frequently there was a company policy not to participate in survey research. The large number of questionnaires many prominent firms are receiving has led them to conclude that survey participation involves too great a drain on executive time.

In view of the previous rationale, a check was made for nonresponse bias by larger firms. Average employment among firms participating in the survey was 10,529. This compares to an average employment level of 11, 268 for a random sample (n=30) drawn from non-responding firms. This difference is not significant in a t-test for mean difference at the 0.05 confidence level.

Since process and content phases of the study presume similarity between database and survey subsamples, their means also were compared in a t-test for mean difference as an indirect assessment of nonresponse bias. The reported disparity was not significant at the 0.05 confidence level. Since IBM, with about 383,000 employees, was in the database sample, but did not participate in the survey, the difference between samples is unduly inflated. Excluding IBM's employment figures from the database sample reduced its average from 22,510 to 14,494. This less variable sample also is not significantly different at the 0.05 confidence level from the survey subsample in a t-test for mean difference.

Job titles reported by respondents vary, but generally indicate top management responsibilities or strategic planning process direction. Of those furnishing such information, 11 (34%) were Chairmen, Presidents, Chief Executive Officers, or Chief Operating Officers. Thirteen (38%) were Senior Vice Presidents, Vice Presidents, or Assistant Vice Presidents. There were 8 (24%) indicating Senior Director or Director responsibilities. Overall, 11 (34%) reported job titles indicating strategic planning process direction.

On average, respondents have accumulated 11 years of experience with their firms. The SPCS configurations they described in the questionnaire have been operating in essentially the same manner for the previous 5 years, on average. The cycle of strategic planning activity repeats on an average of every 1.8 years in these firms. This contrasts markedly with the 3-5 years between synoptic planning exercises in mainstream firms (Camillus and Grant, 1980). Average length of the planning documents generated by firms in the sample is 54 pages.

Average scale scores recorded for each of the six predictor subscales are: integrative capability (4.6), risk accommodation (4.2), technical knowledge focus (4.8), organizational learning enhancement (4.4), vision projection (4.7), and corporate culture salience (5.0).

Survey responses on the question of using nonfinancial performance measures indicates a moderate-to-high level of utilization (average scale score of 5.21). Correlation of this variable with SPCS attributes is in the moderate range (see Table 7, page 78), suggesting that use of nonfinancial measures complements and may enhance the desirable attributes of high technology SPCSs. Its correlation with financial performance (r=0.43) and

perceived SPCS effectiveness (r=0.34) also noted in Table 7 suggests that some performance benefit may accrue to high technology firms choosing to use nonfinancial performance criteria for strategic control purposes.

Only 9 firms included in the database study also returned usable questionnaires, a net response rate of 20% for this category. These respondents were Apple Computer Incorporated, Diebold Incorporated, Digital Communications Associates, Gandalf Technologies Incorporated, Key Tronic Corporation, National Computer Systems Incorporated, NCR Corporation, Stratus Computer Incorporated, and Tandem Computers Incorporated. Relative to the parent samples from which these emerge, this group of firms registers no statistical difference at the 0.05 level from mean levels for both the technology strategy variable set and the SPCS attribute set. There is, however, significantly less variability in R&DSHR, PATRATE, and PATRES in the joint sample, based upon an F-test of variances at the 0.05 significance level.

Although the questionnaire invites unstructured responses regarding SPCS attributes otherwise unaddressed, no comments of this nature were received. The absence of qualitative feedback provides some encouragement that the instrument is comprehensive, but it does raise the question of whether length of the questionnaire may have deterred some from spending additional time composing this type of response. However, even rushed respondents are likely to take the time to note glaring omissions or report important, unique features of their own system that the instrument failed to address.

2. Strategic Planning and Control System-Performance Linkage

In assessing the relationship between SPCS attributes and performance, it is relevant to note that some indicants of SPCS functionality were not confirmed in tests of instrument quality. Neither customer nor supplier interaction with the firm (indicants 1 and 2) was validated as a contributor to integrative capability on the basis of item-total correlations. Nor was there compelling evidence that intensifying competition among technology projects as their funding requirements grow (indicant 21) contributes to risk accommodation. Finally, frequently changing organization structure (indicant 39) did not register as a contributor to organizational learning. In all cases except the supplier-firm interaction (indicant 2), the direction of change in the indicator variables is in the hypothesized direction. Averages scale scores for these variables are 4.5 (indicant 1), 3.5 (indicant 2), 3.9 (indicant 21), and 4.5 (indicant 39). Separate tests of correlation between these indicators and each performance indicator produced a result significant at $p<0.05$ only for customer-firm interaction and stock price performance (r=0.36).

Statistical evidence of association between SPCS attributes and performance appears in Table 7, on page 78. Instrument-measured SPCS variables demonstrate low-to-moderate explanation of performance variance in regression analysis, depending on the degree of independent variable aggregation. When total scale scores are the predictor, adjusted

coefficients of determination range from 0.17 to 0.40, and are significant at the 0.01 level in all cases. Using individual subscales in the predictor set raises adjusted coefficients of determination to the 0.28-0.64 range. All are significant at the 0.01 level except stock price performance explanation, which is significant at the 0.05 level. On the basis of maximum demonstrated explanatory capability, the SPCS qualities captured by the survey instrument appear to have greatest impact on perceived internal performance (SPCS effectiveness and satisfaction with the SPCS), and slightly lesser impact on perceived external performance (financial performance and stock price appreciation).

Correlations between the six attributes and the four performance variables also are reported in Table 7. All subscales exhibit low-to-moderate correlation with at least one predictor variable except technical knowledge focus. Its direction of correlation is consistent with hypothesis 3, but significance levels are below 0.05. On the basis of significant zero-order correlation coefficients, the subscales rank in descending order of importance approximately as follows: organizational learning enhancement, integrative capability, vision projection, risk accommodation, corporate culture salience, and technical knowledge focus.

Since the technical knowledge focus-performance linkage did not achieve statistical significance, the subscale was decomposed in order to search for any residual evidence of performance effect. Among correlations between each of the eight indicants of technical knowledge focus and each of the four performance variables, only indicant #28 (diversity in technologist background) and indicant #30 (technologist interaction with customers) registered significant effects. Both were correlated with performance variable #55 (SPCS effectiveness), the former to low degree ($r=0.34$, $p=0.05$), and the latter to a moderate degree ($r=0.47$, $p=0.01$).

On the basis of evidence from regression analysis and correlation analysis, hypothesis 3 is partially accepted. Results tend to confirm that the SPCS attributes of integrative capability, risk accommodation, organizational learning, vision projection, and corporate culture salience are important determinants of performance for high technology firms. Evidence of a performance benefit assignable to technical knowledge focus in high technology SPCSs is weak. However, planning protocols that invite diversity in technical background among participants and sponsor technologist involvement with customers seem to promote system effectiveness.

3. Strategic Planning and Control System Typology

Cluster analysis of the multi-industry sample of firms participating in the survey indicates the existence of a five-way typology of SPCSs. This process-based typology derives from notable distinctions in subscale scores for the six SPCS attributes of integrative capability, risk accommodation, technical knowledge focus, organizational learning enhancement, vision projection, and corporate culture salience. Associated distinctions

in total scale scores also are reported. Table 8, on page 79, classifies firms participating in the survey according to SPCS type. Table 9, on page 80, summarizes results of the cluster analysis and reports significant differences in process variables among types measured by ANOVA.

All SPCS attributes differentiate among types on the basis of ANOVA results. Pairwise comparisons among types on an attribute-by-attribute basis evaluated for significance using Scheffe's procedure show some degree of type distinctiveness for all types except Type B with respect to corporate culture salience.

Evaluating mean subscale scores according to their descriptors helps to clarify important distinctions among types. Type E scores high or moderate-to-high on all SPCS attributes, positioning it at the extreme high end of the spectrum of SPCS types. This type emerges as the paragon of high technology SPCSs, and is assigned the type label of **Technoplanners** to reflect its exceptional fulfillment of normative standards for planning and control in a high technology context. A leading representative of this type is Zilog Incorporated.

Type B is positioned near the middle of the spectrum of SPCS types. It scores in the moderate-to-high range for all SPCS attributes except vision projection, which falls in the moderate range. Type B is significantly different from Type E with respect to every SPCS attribute except risk accommodation. Close approximation to ideal Type E in capability to handle risk suggests assignment of the descriptor **Technopreneurs** to characterize this SPCS type. A leading representative of the Technopreneurs is Apple Computer Corporation.

Type D. is positioned along the lower half of the spectrum of SPCS types. It scores in the moderate range for all attributes except technical knowledge focus and vision projection, which fall in the moderate-to-high range. Type D is significantly different form Type E with respect to every SPCS attribute except vision projection. Close approximation to ideal Type E in capability for vision projection suggests assignment of the descriptor **Technovisionaries** to characterize this type. Mine Safety Appliances Company is a leading example of the Technovisionaries.

Types A and C are situated at the low end of the spectrum of SPCS types, and both are significantly different from ideal Type E in nearly every category of comparison. Type A scores in the moderate range for all SPCS attributes except risk accommodation, organizational learning enhancement, and vision projection, which fall in the low-to-moderate range. The distinctively low vision projection and generally more conservative posture evident from this SPCS configuration suggest that the descriptor **Technoreactors** is appropriate here. Type C scores in the moderate range for all SPCS attributes except risk accommodation and technical knowledge focus, which fall in the low-to-moderate range. The setting for technical knowledge focus is significantly below that registered by

every other type. The distinctively lower emphasis on technology by this type implies that other management functions have relatively more weight in the SPCS than with the other types. Accordingly, a label of **Technogeneralists** is applied here to reflect a more balanced configuration with less technical bias.

The portrayal of SPCS types decoded by total scale scores largely reinforces the view composed from a consideration of the six separate SPCS attributes, and permits a unidimensional comparison of types. Type E, the Technoplanners, most nearly approximate the ideal SPCS. These firms achieved 81% of the theoretical maximum score on the survey instrument. Type E is most closely approached by Type B, the Technopreneurs. This type achieved 66% of the theoretical maximum score. Ranked behind these two types is Type D, the Technovisionaries. The Technovisionaries compiled a relative score of 61%. Types A and C, the Technoreactors and Technogeneralists, least approximate the ideal high technology SPCS, and are somewhat similar to one another. Both register a relative score on the survey of about 54%.

4. Performance Implications of SPCS Typology

The previous section notes that not all high technology firms configure their SPCSs in exactly the same way. They survey subsample suggests existence of at least five basic variations: Technoreactors, Technopreneurs, Technogeneralists, Technovisionaries, and Technoplanners. While Technoplanners best approximate SPCS ideals from this study, the other forms appear viable. A basis for preferring one over another is the level of performance benefit that associates with each type. This section attempts to identify these differences.

Performance attributes associated with each of the five basic SPCS types are summarized in Table 10, on page 81. Performance distinctions are based upon each of the four performance variables assessed in the survey, as well as a performance composite derived by simple summation of indicators in the performance set. ANOVA tests for performance differences are significant at the 0.01 level for the performance composite and every performance variable except stock price appreciation, which differentiates at a significance level of 0.05. In all categories of performance, Type E, Technoplanners, recorded high or very high mean levels. Pairwise comparisons made using Scheffe's procedure reveal that performance of this type is distinctive from at least one to as many as all four of the other types. Accordingly, it qualifies as the performance leader in the high technology SPCS typology.

Types A and D, Technoreactors and Technovisionaries, are associated with performance levels distinctively lower than Type E in nearly every category of comparison. Accordingly, they qualify as the least desirable types in the set. Technoreactors exhibit low-to-moderate performance in every category except SPCS effectiveness, where the level is low, and in financial performance, where the level is moderate.

Technovisionaries exhibit mean performance levels in the low-to-moderate range for all categories except SPCS effectiveness and financial performance, where levels are moderate.

Types B and C, Technopreneurs and Technogeneralists, most closely approximate the performance levels of Type E, Technoplanners. Performance levels for Technopreneurs are moderate in all categories except financial performance, where the level is moderate-to-high. Economic performance of Technopreneurs, reflected by financial performance and stock price appreciation, is not significantly different from that achieved by Technoplanners. Performance levels for Technogeneralists are moderate in all categories except financial performance and stock price appreciation, where levels are moderate-to-high. Stock price performance and satisfaction with the SPCS among Technogeneralists are not significantly different from that of Technoplanners.

Evidence of performance differences across the SPCS typology described in this section largely confirms hypothesis 4. The basic types of SPCS in use by high technology firms do appear to deliver different levels of performance benefit. The principle of equifinality is evident, however. That is, some SPCSs with distinctive process differences appear to deliver nearly equivalent performance response.

C. SYNTHESIS OF DATABSE AND SURVEY RESEARCH

Results of efforts to reconcile content and process research findings produced by this study are described in this section. Focus is on similitude of strategic group structures generated from the alternative bases of technology strategy content (R&D policy, patent policy, and facility management) and technology strategy process (SPCS attributes) in the computer industry.

The sample of interest here is the collection of firms employed in the database research effort that also responded to the survey with a completed questionnaire. The inevitable sample attrition associated with mail surveys reduced the 46 potential candidates for this portion of the study to only nine, a net recovery of 20%. These firms, along with their strategic group identity resulting from strategy content considerations per Table 4, are: Digital Communications Associates, Gandalf Technologies Incorporated, and NCS Corporation (Strategic Group 1); Apple Computer Corporation (Strategic Group 2); Diebold Incorporated and Key Tronic Corporation (Strategic Group 3); Stratus Computer Incorporated and Tandem Computers Incorporated (Strategic Groups 4); and National Computer Systems Incorporated (Strategic Group 5).

Classification of these same firms, according to the multi-industry SPCS typology developed on the basis of technology process considerations per Table 8 is: Apple Computer Corporation, Stratus Computer Incorporated, and Tandem Computers Incorporated (Technopreneurs); Diebold Incorporated and National Computer Systems

(Technogeneralists); and Digital Communications Associates, Gandalf Technologies Incorporated, Key Tronic Corporation, and NCR Corporation (Technovisioinaries).

An explicit strategic group structure derived from a strategy process basis was not developed for this sample category because of the small number of firms involved. However, the methodology used to construct the SPCS typology is identical to that employed for strategic group analysis. It faithfully maps the relative arrangement of these firms in Euclidean space defined by SPCS process variables and is unaffected by the presence or absence of additional firms from within or outside the computer industry. Therefore, comparing Euclidean distance coefficients among these firms in strategy process space with Euclidean distance coefficients among the same firms in strategy content space provides a convenient basis for evaluating coalignment of strategic group structures.

Simple correlation or process-based and content-based matrices constructed from their respective Euclidean dissimilarity coefficients resulted in a Pearson correlation coefficient of 0.12, which is not significant at the 0.05 level. Accordingly, the hypothesis (5) that strategic groups in the computer industry derived from strategy process distinctions are similar to strategic groups derived from strategy content distinctions is rejected.

Because of negative results here, this line of investigation was extended to uncover a possible explanation. Robust regression analysis was performed using the resemblance data for strategy content as the dependent variable with the hope of finding the locus of misfit between the two resemblance matrices. The regression coefficient stabilized when low weight was given to data involving NCR Corporation. Its technology strategy content is noticeably fuller than other firms in the sample, primarily as a result of high R&DSHR, PATRATE, and PATRES. Robust estimation improves the correlation coefficient to 0.29, which is significant at $p=0.08$. However, this still is very weak evidence of strategic group similarity.

Table 3

Association Between Technology Strategy Content and Performance
in the Computer Industry

Performance Variables	Technology Strategy Variables					
	R&DINT	R&DSHR	PATRATE	PATRES	PATINDX	AGE
SLSCHG	0.05	0.91**	0.89**	0.86**	-0.05	0.00
[0.83]**		0.52**	0.51**	0.34*		
SLSCHG%	0.20	-0.17	-0.18	-0.17	0.56**	-0.68**
[0.45]**					0.53**	-0.83**
NICHG	0.02	-0.82**	-0.88**	0.91**	0.22	-0.18
[0.82]**		0.06	0.18	0.12		
ROS	-0.05	0.15	0.14	0.11	0.16	-0.45**
[0.21]*						-0.36**
ROA	-0.16	0.06	0.05	0.02	0.25*	-0.54**
[0.34]**					0.14	-0.44
STKRET	0.03	0.05	-0.05	-0.06	0.33**	-0.30*
[0.00]					0.39**	-0.38**
Notes	Pearson correlation coefficient appears above Spearman correlation coefficient. [adjusted coefficient of determination with all independent variables in the regression model] * p<0.05 ** P<0.01					

Table 4

Strategic Groups in the Computer Industry
Based on Technology Strategy

Strategic Group 1 **(13 Firms)** Control Data Corporation Data General Corporation Digital Communications Associates Dynatech Corporation Gandalf Technologies Incorporated Hewlett-Packard Company NCR Corporation Par Technology Corporation Storage Technology Corporation UNISYS Corporation Wang Laboratories Western Digital Corporation	**Strategic Group 2** **(12 Firms)** Apple Computer Corporation Archive Corporation Atari Corporation Compaq Computer Corporation Conner Peripherals Intermec Corporation MAI Basic Four Incorporated Maxtor Corporation Micropolis Corporation Seagate Technology Smith Corona Corporation Symbol Technologies
Strategic Group 3 **(6 Firms)** Diebold Incorporated General Binding Corporation Iomega Corporation Key Tronic Corporation NBI Incorporated Printronix Incorporated	**Strategic Group 4** **(7 Firms)** Amdahl Corporation Cray Research Network Equipment Technology Silicon Graphics Incorporated Stratus Computer Incorporated Sun Microsystems Incorporated Tandem Computers Incorporated
Strategic Group 5 **(7 Firms)** AST Research Incorporated Cherry Corporation Dell Computer Corporation National Computer Systems Incorporated Pitney Bowes Incorporated QMS Incorporated Tandy Corporation	**Strategic Group 6** **(1 Firm)** International Business Machines

Table 5

Technology Strategy Content Characteristics of Strategic Groups
in the Computer Industry

Strategic Group	Technology Strategy Content Variables					
	R&DINT **/**	R&DSHR **/**	PATRATE **/	PATRES **/	PATINDX **/**	AGE **/**
1	9.3 (2345) [2345]	3.2 (26) [235]	38 (6)	746 (6) [25]	1.3 (24) [24]	5.9 (234) [234]
2	5.3 (14) [14]	0.3 (16) [146]	3 (6) [6]	17 (6) [16]	3.8 (1356) [135]	3.6 (1356) [1356]
3	5.8 (14) [14]	0.1 (6) [146]	2 (6) [6]	41 (6)	1.3 (24) [24]	10.8 (12456) [1245]
4	14.0 (1235) [1235]	0.8 (6) [235]	5 (6)	32 (6) [6]	3.6 (1356) [135]	3.1 (1356) [1245]
5	3.0 (14) [14]	0.2 (6) [146]	11 (6) [6]	161 (6) [16]	1.3 (24) [24]	5.5 (2346) [234]
6	7.5	46.6 (12345) [235]	617 (12345) [235]	11914 (12345) [245]	1.1 (24)	7.9 (2345) [24]
Notes	Significance of differences among strategic groups in ANOVA precedes slash. Significance in Kruskal-Wallis test follows slash. (groups different in ANOVA using Scheffe's multiple comparison procedure at alpha=0.1) [groups different in Kruskal-Wallis test using Conover's multiple comparison procedure at alpha=0.1] * p<0.05 ** P<0.01					

Table 6

Performance Characteristics of Strategic Groups
in the Computer Industry

Strategic Group	Performance Variables					
	SLSCHG **/**	SLSCHG% **/**	NICHG **/	ROS	ROA */	AGE /*
1	375 (6) [3]	15.7 (24) [24]	-6.6 (6)	3.5	4.0	-5.0 [24]
2	210 (6) [3]	56.0 (13) [1356]	15.5 (6) [6]	6.1 [3]	8.5 [3]	19.1 [135]
3	3 (6) [12456]	1.5 (24) [245]	0.0 (6)	-0.1 [2456]	-0.5 [245]	-2.4 [24]
4	180 (6) [3]	65.8 (13) [136]	9.8 (6) [6]	7.0 [3]	7.9 [3]	17.5 [13]
5	124 (6) [3]	26.6 [23]	4.6 (6)	5.9 [3]	7.8 [3]	-4.5 [2]
6	3163 (12345) [3]	5.8 [24]	-699 (12345) [24]	9.5 [3]	8.3	-7.4
Notes	Significance of differences among strategic groups in ANOVA precedes slash. Significance in Kruskal-Wallis test follows slash. (groups different in ANOVA using Scheffe's multiple comparison procedure at alpha=0.1) [groups different in Kruskal-Wallis test using Conover's multiple comparison procedure at alpha=0.1] * p<0.05 ** P<0.01					

Table 7

Association Between Strategic Planning and Control System Attributes and Performance in High Technology Firms

Regression Analysis (Adjusted Coefficient of Determination)		
Performance (Indicant)	*Subscale Basis*	*Scale Basis*
SPCS Effectiveness (55)	0.64**	0.33**
Financial Performance (56)	0.50**	0.40**
Stock Price (57)	0.28 *	0.17**
Satisfaction w/ SPCS (58)	0.50**	0.22**
Correlation Analysis (Pearson Correlation Coefficient)		
Subscale	*Performance Indicant #55*	*Performance Indicant #56*
Integrative Capability	0.56**	0.62**
Risk Accommodation	0.40 *	0.59**
Technical Knowledge Focus	0.28	0.17
Organizational Learning Enhancement	0.64**	0.70**
Vision Projection	0.62*8	0.36 *
Corporate Culture Salience	0.27	0.50**
Subscale	*Performance Indicant #57*	*Performance Indicant #58*
Integrative Capability	0.52**	0.52**
Risk Accommodation	0.39 *	0.30
Technical Knowledge Focus	0.01	0.11
Organizational Learning Enhancement	0.50**	0.60**
Vision Projection	0.24	0.53**
Corporate Culture Salience	0.31	0.29
Subscale/Performance Indicant	*Nonfinancial Measure Usage*	
Integrative Capability	0.48**	
Risk Accommodation	0.55**	
Technical Knowledge Focus	0.54**	
Organizational Learning Enhancement	0.55**	
Vision Projection	0.48**	
Corporate Culture Salience	0.48**	
SPCE Effectiveness	0.34 *	
Financial Performance	0.43**	
Stock Price	0.16	
Satisfaction w/ SPCS	0.25	
* $p < 0.05$ ** $p < 0.01$		

Table 8

Classification of Surveyed Firms According to the
High Technology Strategic Planning and Control System Typology

Technoreactors Harris Corporation Mark IV Industries Optek Technology	**Technogeneralists** Cooper Industries Diebold Incorporated National Computer Systems Incorporated Recognition Equipment Incorporated Square D Corporation Whirlpool Corporation
Technopreneurs AEL Defense Corporation Apple Computer Corporation Cordis Corporation Evans & Sutherland Computer Corporation Millipore Corporation Qume Corporation Stratus Corporation Tandem Computers Incorporated Teradata Corporation 3COM Corporation	**Technovisionaries** Digital Communications Associates Gandalf Technologies Incorporated Johnson Controls Incorporated Key Tronic Corporation Mine Safety Appliances Company NCR corporation
	Technoplanners Invacare Corporation Sensormatic Electronics Corporation Sheldahl Incorporated Sunrise Medical Incorporated Watkins Johnson Company Zilog Incorporated

Table 9

Process Characteristics of the
High Technology Strategic Planning and Control System Typology

SPCS Attribute	Subscale Scores by SPCS Type				
	A ***Techno-reactors***	***B*** ***Techno-preneurs***	***C*** ***Techno-generalists***	***D*** ***Techno-visionaries***	***E*** ***Techno-planners***
Integrative Capability**	54 (E) [4.2]	60 (DE) [4.6]	54 (E) [4.2]	D (BE) [4.0]	74 (ABCD) [5.7]
Risk Accommodation**	39 (39) [3.3]	55 (ACD) [4.6]	37 (BE) [3.1]	44 (BE) [3.7]	64 (ACD) [5.3]
Technical Knowledge Focus**	30 (C) [3.8]	38 (CE) [4.8]	26 (ABDE) [3.3]	40 (CE) [5.0]	62 (BCD) [5.9]
Organizational Learning Enhancement**	35 (BE) [3.2]	49 (AE) [4.5]	43 (E) [3.9]	44 (E) [4.0]	62 (ABCD) [5.6]
Vision Projection**	15 (BCDE) [3.0]	22 (ADE) [4.4]	22 (AE) [4.4]	26 (E) [5.2]	29 (ABC) [5.8]
Corporate Culture Salience**	20 (E) [4.0]	26 [5.2]	22 (E) [4.4]	22 (E) [4.4]	31 (ACE) [6.2]
Total Scale**	203 (BE) [3.8]	251 (ACDE) [4.6]	205 (BDE) [3.8]	229 (BCE) [4.2]	306 (ABCD) [5.7]
Notes	Significance of differences among SPCS types in ANOVA indicated by asterisks. Parenthetic letters indicated types different in ANOVA using Scheffe's multiple comparison procedure at alpha=0.1. Mean scale scores are bracketed.				
	* $p < 0.05$ ** $p < 0.01$				

Table 10

Performance Characteristics of the
High Technology Strategic Planning and Control System Typology

Performance	Performance Subscale Scores by SPCS Type				
	A ***Techno-reactors***	***B*** ***Techno-Preneurs***	***C*** ***Techno-generalists***	***D*** ***Techno-visionaries***	***E*** ***Techno-planners***
SPCS Effectiveness**	2.3 (E)	3.6 (E)	4.0 (E)	4.0 (E)	5.8 (ABCD)
Financial Performance**	3.7 (E)	5.4	4.5 (E)	3.8 (E)	6.8 (ACD)
Stock Price*	3.3	4.4 (E)	4.8	3.2 (E)	6.2 (D)
Satisfaction w/ SPCS**	2.7 (E)	3.6 (E)	4.2	3.2 (E)	5.5 (ABD)
Composite**	12.0 (E)	16.9 (E)	17.5 (E)	14.2 (E)	24.3 (ABCD)
Notes	Significance of differences among SPCS types in ANOVA indicated by asterisks. Parenthetic letters indicated types different in ANOVA using Scheffe's multiple comparison procedure at alpha=0.1.				
	* $p < 0.05$ ** $p < 0.01$				

Figure 3

Strategy Map for the Computer Industry

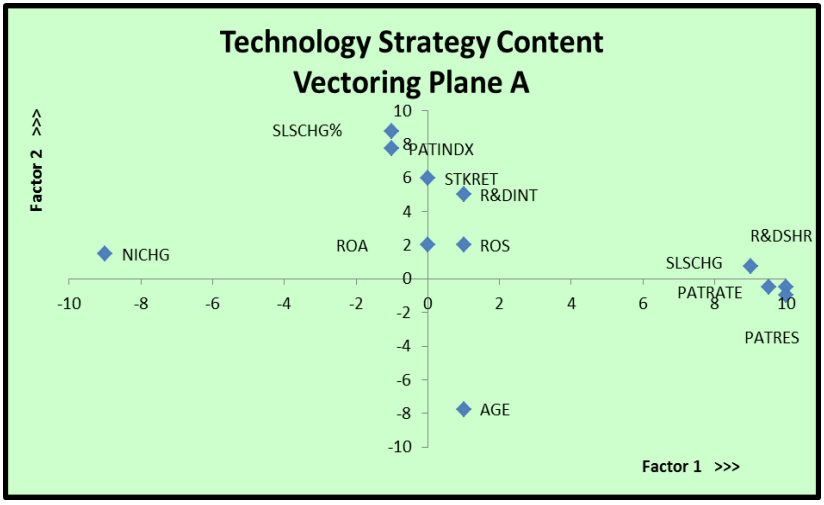


Figure 4

Strategy Map for the Computer Industry

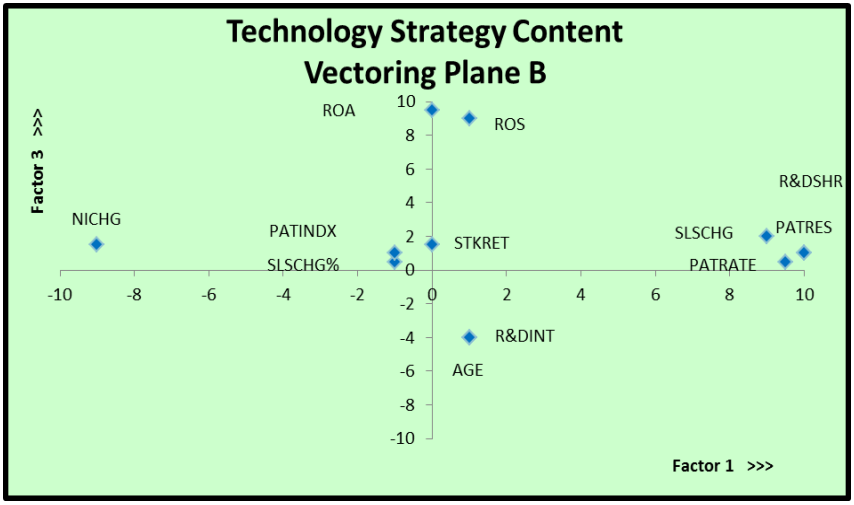


Figure 5

Strategy Map for the Computer Industry

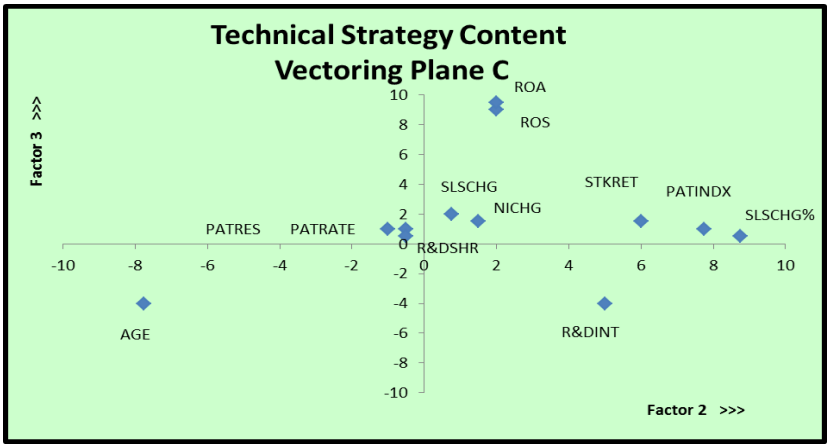
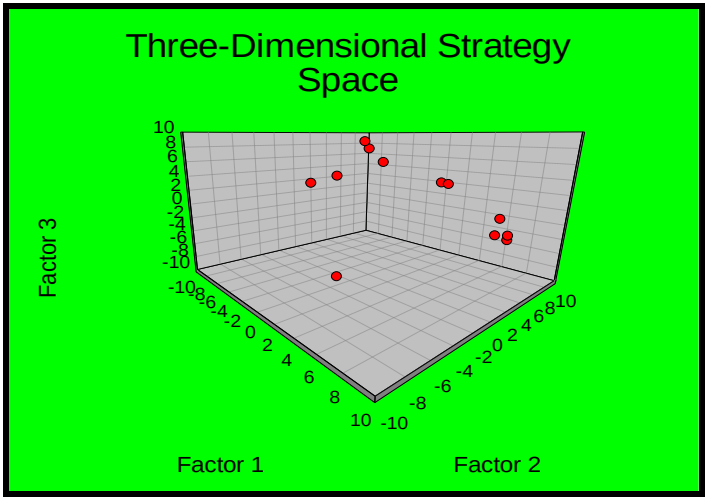


Figure 6

Volumetric Strategy Map for the Computer Industry
(Technology Strategy Content Space)



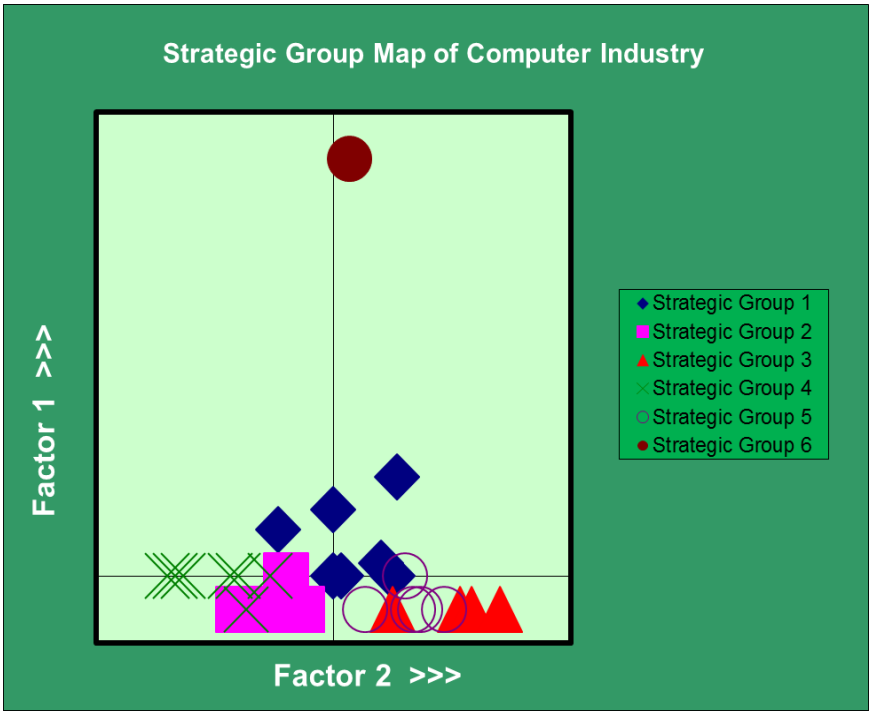
Figures 3-6 Explanation: Collectively, 12 variables finely compose Strategy Space (that is, the Technology Content Strategy-Performance Domain). Dimensionality of Strategy

Space was reduced from twelve to three via Factor Analysis. Sometimes Factors may be interpreted *a posteriori* to illuminate super-dimensions, but these three were not. A benefit of three-space geometry is power to see the relevant X-by-Y-by-Z cube as volumetric natural space or from the perspective of three planes or "windows" on volumetric space: XY (Plane A), XZ (Plane B), and YZ (Plane C). Strength vectors populating Strategy Space are not explicitly drawn, but may be contemplated for direction by lines connecting each plotted diamond point (the vector arrow head) with the origin. Axis rotation within Factor Analysis largely orients Strategy Strength Vectors near rotated axes for a cleaner, simpler understanding.

Figure 6 synthesizes the separate planar views to a single Volumetric Strategy Space. The three-dimensional scenery becomes more impressive, but loss of Strategy Vector reading accuracy occurs. It may seem confusing to perceive Strategy Space in two or three dimensions without knowing exactly what each super-dimension means. This apparent imprecision is not a real detriment to understanding the lessons of Strategy Space. With three or less dimensions, the eye can make the translation to real space easily and memorably. Within that tractable spatial environment, the magnitudes and positions of Strategy Vectors, which are precisely specified variables, can be assessed and interpreted *relatively*. Figuratively, captains of industry pilot their respective ships with reference to each other, moreso than to some absolute standard.

Strategy Mapping has value because it reduces the task of digesting voluminous data (complexity) on the way to simple, powerful understanding. It taps left-brain instant recognition by invoking graphical displays with easy interpretability. Among issues that become addressable through the foregoing Strategy Maps are: (1) What Strategy Content Variables associate closely with Performance Variables? For example, PATINDX closely associates with SLSCHG%. (2) What Strategy Content Variables move opposite Performance Variables? For example, PATRES is inverse to NICHG. (3) What Strategy Content Variables tend to collaborate? For example, R&DSHR, PATRATE, and PATRES tend to work together. (3) What Performance Variables tend to move coherently? It is clear that ROS and ROA track similarly. Finally, what Strategy Variables most dominate Strategy Space? For example, AGE, PATINDX, and R&DSHR sway matters saliently, while PATINT has somewhat less sweeping influence.

Figure 7
Strategic Group Map for the Computer Industry
(Technology Strategy Content Basis)



The six strategic groups composing the computer industry are portrayed in the Strategic Group Map above. While boundaries for each Strategic Group have not been drawn, it is possible to visualize their locus by evident clustering of Strategic Group members. Factors 1 and 2 dimension High Technology Industry Space in a general way, but are not individually interpreted. The dimension reduction process abstracts many complex strategy and performance variables, translating them into a form language easily comprehended. The basic benefit of spatial array in the Strategic Group Map is its ability to generally differentiate industry position according to strategic choice. Tractable word descriptions of these choices are elaborated using familiar management terms in the Results chapter of the text. It is possible to finely differentiate individual firms in a Strategic Group Map, however summary quality becomes obscured by busy-ness of the display. The strategic group is a more generalized entity of industry structure than the individual firm, and the exhibited Strategic Group Map serves that intermediate aggregation purpose. It is more refined and less generalized than the full industry. Accordingly, Strategic Groups and Strategic Group Maps are helpful intermediate (medium-grained) structures for comprehending industry behavior. They also are efficiently evocable by sampling (rather than census), benefiting from central tendency phenomena within a multi-centroid (diversified) industry structure.

Chapter VI
DISCUSSION OF RESULTS

An attempt will be made in this chapter to amplify the findings of the previous chapter and explain anomalous results. The discussion is structured around the three dominant relationships dealt with in this research: those relating strategy content to performance, those relating strategy process to performance, and the process-content relationship, itself.

Perspective Pi: Notable in the analysis of results is a life-cycle dynamic for strategic behavior of high-tech firms. Advanced statistical, quantitative, and qualitative analyses help to express this dynamic in words and numbers, that is, it can be measured and understood. Science and management are inclined to stop there. The utilitarian nature of such understanding will allow competitors to better manage themselves within the industry paradigm. Philosophically and spiritually, however, craftsmanship is not complete. Before us is a picture of corporate life processes moving at extreme pace, regarded by more than a few experts and industry analysts as a destructively rapid pace. Think in terms of dollars and equipment, and the give-and-take of destructive competition seems natural and tolerable. Consider the matter in terms of lives corporately bound together, rising and falling, being created and being destroyed, and the fray is not a picture of humane, moderate, conservative endeavor. In this racy domain, many steeds and masters don't finish the race. There is a lot of collateral damage as any falls. Christians might realistically ask if there is a kinder, more loving way to meet society's need for high technology products? Do these companies of human beings have time to "smell the roses" along the way of writing history? Are family values supportable among these continually reforming corporate creatures? Can corporate life be extended (made healthier), periods of stability prolonged (less upheaval), less money wasted (moderate the appetite for and speedy waste of societal cash)? In other words, can this corporate citizenry live a more normal, peaceful life? Investing God in high technology will correct many of the evident problems. Our all-seeing and all-knowing God **sets** men and companies in solid places, and does not run the vessel recklessly into collisions or high maintenance. He will not sacrifice quality of life for profits or competitive position. He delivers abundant life on a sober, enjoyable course of progress. Investing Christ in strategic planning and control is the greater result of this dissertation's analytical process.

William C. Patterson Ph.D.

Perspective Pi.WMA

*Why do the heathen rage, and the people imagine a vain thing? The **kings of the earth set themselves**, and the rulers take counsel together, against the LORD, and against his anointed, saying, Let us break their bands asunder, and cast away their cords from us. He that sitteth in the heavens shall laugh: the Lord shall have them in derision. Then shall he speak unto them in his wrath, and vex them in his sore displeasure. Yet have **I set my king upon my holy hill** of Zion. I will declare the decree: the LORD hath said unto me, Thou art my Son; this day have I begotten thee. Ask of me, and I shall give thee the heathen for thine inheritance, and the uttermost parts of the earth for thy possession. Thou shalt break them with a rod of iron; thou shalt dash them in pieces like a potter's vessel. Be wise now therefore, O ye kings: be instructed, ye judges of the earth. **Serve the LORD with fear, and rejoice with trembling**. **Kiss the Son, lest he be angry, and ye perish** from the way, when his wrath is kindled but a little. **Blessed are all they that put their trust in him**. Psalm:2.1-12*

A. TECHNOLOGY STRATEGY CONTENT RELATIONSHIPS

Of the technology strategy variables studied, relative patent activity (PATINDX) and age of fixed assets (AGE) have the widest affect on performance. It appears that technology decisions that keep the rate of patenting on an ever-increasing path and equip the firm with the most modern facilities grant computer industry participants wide-ranging success. Most affected are relative potential realization (SLSCHG%), relative profitability (ROS), relative asset efficiency (ROA), and return to shareholders (STKRET). Since all are relative performance measures unrelated to scale of operations, these two strategy variables might be regarded as **initiators** of competitive advantage.

Influencing success less in scope but more in degree are R&D share (R&DSHR), patenting rate (PATRATE), and size of the patent reserve (PATRES). They are potent drivers of absolute growth and probably drive absolute profit as well. Here, it seems that long-term commitment to proprietary technology development and relentless pursuit of technological dominance ultimately results in capability to exploit the potential of the industry on a large scale and to reap large economic rewards. These three strategy variables appear to be **sustainers** of competitive advantage.

It is somewhat surprising that R&D intensity registered insignificant evidence of causal connection to the array of performance variables. This probably is the most widely recognized and used operationalization of R&D policy. There undoubtedly is a small, delayed performance effect that could have been revealed by a suitable time-series research design. "Noise" introduced by sales fluctuations and the stochastic nature of R&D outputs no doubt helped to mask the steady-state effect here. It appears that commitment to high R&D intensity over the long term is desirable and can eventually lead to high R&D share, but only the latter brings sizeable reward. According to this logic, R&DINT also might be classified as an **initiator** of competitive advantage.

It is interesting to speculate why technology strategy has a stronger connection with sales growth than it does with profitability (per Tables 3 and 6). Perhaps technology strategy has more to do with "opening the door of industry opportunity" via sales expansion than it does with profitably seizing that opportunity. Other dimensions of management dealing with administrative efficiency, cost containment, or marketing may figure more prominently in the latter.

Trade-offs that technology strategy presents firms in this industry are highlighted by the strategy maps in Figures 3 through 5. Notice that relative profitability (ROS) and asset efficiency (ROA) are affected primarily but weakly by R&D intensity (R&DINT) and age of fixed assets (AGE) per Figure 4. Presumably, cost efficiencies associated with modern facilities bring improvement to these performance measures. However, heightened R&D intensity emerges as a detractor, at least for the near term. Firms

emphasizing current performance might be tempted to sacrifice R&D on the basis of this information alone. However, the positive association R&D has with relative potential realization (SLSCHG%) shown in Figure 5 suggests that future growth also would be penalized by R&D curtailment. These trade-offs are not as readily evident from correlations coefficients in the unreduced data space. The variance-magnifying effect of principal components analysis and factor rotation helps to draw out these subtleties.

It is not surprising that the two most successful strategic groups keyed their strategy on vigorous growth of proprietary technology and investment in modern facilities, the most influential technology strategy variables found in this study. Mobility barriers insulating these groups appear to be their strong technologist corps, state-of-the-art facilities, astute management, and financial strength.

Strategic Group 3 appears to exemplify what happens when firms neglect to go forward with a strong technology strategy in the computer industry. Either by choice or default, these firms assumed the least favorable technology strategy configuration observed among the six strategic groups. They pursued minimally competitive policies regarding R&D, proprietary technology development, and facilities, and they achieved the poorest overall group performance.

Strategic Groups 1, 5, and 6 essentially stack up as mid-range performers in the computer industry. The strategic postures of Groups 1 and 6 emphasize choices which sustain competitive advantage. Both groups are the dominant generators of industry R&D and work from the greatest reserve of proprietary technology, which they augment at the highest absolute rate. The sheer size and probable depth of their technologist core coupled with an immense inventory of proprietary technology figure prominently as mobility barriers.

Strategic Group 5 has the weakest technological posture of the mid-range performers in the industry, but does not appear to suffer for that from the standpoint of performance. Strengths in marketing or other non-technical management areas appear to be compensating here.

The strategic group map in Figure 6 is helpful in visualizing the dynamics of competition in the computer industry. Viable technology strategies appear to be circumscribed by an isosceles triangle with its base parallel to the bottom of Figure 6 and its apex pinned by Strategic Group 6 (IBM). The ideal locus of industry entry would be along the left side of the base. Strategic groups in this area have the newest plant and equipment, greatest relative commitment to R&D, and most rapid rate of proprietary technology buildup. These strategic attributes initiate competitive advantage and are the most broadly rewarded. Organizational development would appear to involve moving upward on the map with strategies moderating as the left side of the triangle converges toward the apex. Competitive forces appear to drive firms into strategic groups along the right side of the

triangle with Strategic Group 3 occupying a position held with least resistance. Firms maintaining strong commitment to a technology strategy focused on the initiators of competitive advantage eventually find their strategic profiles augmented by the sustainers of competitive advantage: high R&D share, high absolute rate of patenting, and a large inventory of proprietary technology. This stature is exemplified by Strategic Group 1, which approaches the centroid of the triangle. Relentless pursuit of the technology strategy frontier pinned by Strategic Groups 4 and 6 (the left side of the triangle) eventually would result in entry to Strategic Group 6, now occupied by only one competitor (IBM). This is the most evolved firm and strategic group in the industry.

B. STRATEGIC PLANNING AND CONTROL SYSTEM RELATIONSHIPS

Survey results indicate that SPCSs in high technology firms exhibit moderate levels of risk accommodation and organizational learning enhancement on average. With respect to integrative capability, technical knowledge focus, vision projection, and corporate culture salience, the SPCSs in high technology firms exhibit moderate-to-high functionality. All of these attributes contribute in some degree to important dimensions of performance except technical knowledge focus. SPCSs characterized by technically-grounded top management with a hands-on style, highly-specialized technologist input to strategic planning and control, or policies of tapping external sources of technology may help provide admission to the high technology arena, but these features do not seem to influence how successfully the game is played. There is an indication, however, that bringing technical diversity to the planning process, and having a policy of technologist involvement with customers, is beneficial to SPCS effectiveness.

SPCSs that enhance organizational learning and excel at integrative capability provide the strongest and broadest performance benefit. Customer responsiveness, openness to technological change, organicity, flexibility, and willingness to experiment are among the affirmed qualities of a learning organization that the SPCS needs to facilitate. SPCSs which prompt frequent changes in organization structure, however, do not appear to be beneficial. Presumably, well-planned and executed changes have greater staying power than those made in a less-informed, reactive mode, and are associated with superior management.

Integration of entities within the organization such as marketing with R&D, engineering with manufacturing, and strategic planning with technological activities of the firm also are important functions of a high technology SPCS. Maintaining close relationships with customers seems to benefit stock price performance, however fostering interaction with suppliers failed to register significant benefit. While the theoretical basis for firm-supplier interaction has been expounded in the literature, it may be that the practicalities of competitive behavior short-circuit theory. Both customers and suppliers interact with the firm's competitors. An upstream bias regarding information flow may protect the organization in customer relations, but granting suppliers intimate access to the firm may

channel sensitive data into the competitive environment that could compromise the firm's competitive position. Finding a more secure and non-threatening arrangement for integrating suppliers with the firm emerges from this study as a future challenge.

An SPCS configured to do a good job of projecting top management's vision for the organization is greatly valued by high technology firms and carries with it financial performance benefit. Emphasis given to visionary leadership, administrative support of the vision through the organization's mission and objectives structure, and a patient control posture enhance the perception of SPCS effectiveness and engender a sense of satisfaction with it among organizational members.

Ability of an SPCS to accommodate risk improves the level of financial performance achievable by high technology firms. It also increases the perception of SPCS effectiveness and the organization's satisfaction with the system. Contributory qualities include empowerment and resourcing of entrepreneurial/intrepreneurial managers and product/process champions, providing incentives for risk-assumption (including protection from down-side risk), and affording adequate risk-sharing and risk-hedging mechanisms.

High technology firms rely moderately-to-highly on corporate culture for behavior management. It is instrumental in establishing an atmosphere to which creative people are drawn and where they can both function and flourish. SPCSs which allow the firm to be driven more by a strong, positive culture than by formal mechanisms augment financial performance.

An encouraging result in the search for multi-industry SPCS typologies and their performance correlates is that firms excelling in all six attribute categories measured by the questionnaire do exist (the Technoplanners) and do receive a high performance benefit because of their process excellence. The type most closely approximating the Technoplanners in process attributes, the Technopreneurs, also came closest to mirroring their financial and stock price performance.

While the Technovisionaries exhibited a somewhat better SPCS configuration than the Technogeneralists according to the process norms of this research, stock price performance and internal satisfaction with the system for the latter more nearly approximates that of the Technoplanners. It may be that the less aggressive posture of Technogeneralists regarding risk accommodation and technical knowledge focus carries a minimal performance penalty (which is consistent with findings on the technical knowledge focus-performance link). Alternatively, the Technogeneralists may occupy a strategic niche that simply fits and rewards that posture.

Technoreactors only moderately approximate the ideal SPCS configuration for high technology firms. Their leanings toward the more traditional SPCS model appear to

relegate this type to performance levels in the low-to-moderate range for this environment.

Perspective Rho: As society and business life becomes more complex, there is a counter evolution towards oversimplification to create a sense of being able to grasp and control unwieldy sophistication. The business world often is reduced to the Fortune 500. Stock markets are simplified to the Dow-Jones Averages. Excellence in America's 20,000+ corporations is characterized by 8 companies. There are endless reviews of Top Ten entities, seeming to capture the essence of the whole by delineation of this magical elite. Inquisitive minds are thirsty for this reductionism, often leveraging the unrepresentative information into a sensational and brutal competition. Typological constructs and thinking is far kinder and faithful to reality. Business is not a totem pole. It is a community of public servants with diverse talent. Society is well served by the variety. We surely receive most interesting products when diverse minds and cultures give birth to innovation, rather than newness spilling from plain vanilla, single-recipe process. America has been a pre-eminent Father of Many Nations, faithful to the Abrahamic Covenant known by every Christian and Jew (see below). A modern Father Abraham, Abraham Lincoln, kept the United States from slavery separatism, preserving unity instrumental to God's perpetual covenant. Derivatively, we have become the most innovative people in history. Cultural richness and divine inspiration make it happen. The typology found in high-tech industry testifies to persistence of the diversity, tolerance, acceptance, and collaboration themes that uniquely compose America's success story. Hopefully there will be less of "big fish eating little fish" in endless, predative competition, and more of letting natural diversity express itself, each type of industry "personality" finding a place in the sun.

William C. Patterson Ph.D.

Perspective Rho.WMA

*Thy name shall be Abraham; for a **father of many nations** have I made thee. Genesis:17.5 And I will make thy seed to multiply as the stars of heaven, and will give unto thy seed all these countries; and **in thy seed shall all the nations of the earth be blessed**. Genesis:26.4*

C. CONTENT-PROCESS SYNTHESIS ISSUES

The attempt to synthesize technology strategy content results with technology strategy process results by demonstrating coalignment of strategic group structures emerging from those two different bases was not successful, and represents the major theoretical disappointment of the study. Smallness of the joint sample may have contributed to the very low coincidence of strategic group structures observed. The distinctiveness of NCR Corporation's technology strategy content among the sampled firms no doubt exacerbated the problem. However, the real value of that anomaly rests in its illumination of process-content specification conventions as the source of incongruence.

Technology strategy content, as it has been operationalized in this study, subtly encompasses a temporal dimension. R&DINT, PATRATE, and AGE qualify as contemporary content variables inasmuch as strategists have rather complete discretion in setting these during the five-year timeframe analyzed. R&DSHR, PATRES, and PATINDX, however, are content variables whose levels depend to a significant degree on decisions extending back in time a considerable distance. Incorporating this duality in

the variable set is highly desirable because technology benefits frequently lag strategic choice and often depend on the degree to which the firm's commitment to technology is sustained. Broad affirmation of the linkage between technology strategy content and performance (H1) validates the logic of establishing this duality among predictor variables.

The treatment of technology strategy process in this study is not parallel to that given technology content regarding the time dimension. All SPCS attributes are instantaneous measures and do not capture historical effects, such as commitment to persistence. Accordingly, identical SPCS configurations could produce a technology strategy rich in the time-developed sustainers of competitive advantage or, alternatively, one rich only in the initiators of competitive advantage. These content differences arise not from a different pattern of SPCS attributes, but from difference in the length of time that the SPCS commits to a particular configuration of contemporary technology strategy content variables. Under these circumstances, it is unreasonable to expect a good content-process match.

This result is not atypical. Processes usually are characterized by steady-state properties, while their outputs often are characterized by both steady-state and cumulative properties. The choice to combine steady-state and cumulative attributes in the technology strategy variable set of this research effort essentially predestined weak strategy process mirroring.

Chapter VII
CONCLUSIONS FROM THE RESEARCH

This research project has focused on high technology firms in an attempt to expand the frontier of management knowledge pertaining to strategic planning and control within this context. A review of literature on formal strategic planning, strategic control, and technology strategy, coupled with anecdotal evidence from experiences of technology-oriented firms, suggests existence of a tripartite conceptual framework for this work that is rooted in industrial organization economics theory. Within this framework, conceptualizations of the business environment, planning, and control relevant to high technology enterprise are observed to contrast markedly with traditional views from the mainstream of strategic management. Traditional business environments are relatively stable and easier to analyze and predict, while high technology environments possess degrees of complexity, dynamism, and uncertainty that considerably frustrate traditional planning and control protocols. Formal, comprehensive approaches to strategic planning characteristic of the traditional model give way to more tentative approaches among high technology firms involving prudent experimentation focused by a strong, entrepreneurial vision. Likewise, the rigid feedback controls schemes embodied in traditional control models are superceded by adaptive, feedforward control mechanisms to accommodate the demands of high technology service.

The theoretical position supported by the reviewed literature and conceptual framework is that strategic planning and control systems ideally suited for high technology firms should possess high positive loadings on six attributes. Rapid and complex technological change require SPCSs that have exceptional capability to integrate diverse internal and external entities. These include integrating customers with the firm, marketing with R&D, engineering with manufacturing, etc. Successfully managing uncertainty requires SPCSs with considerable ability to accommodate risk. Empowerment of entrepreneurs/technology champions and incentives for experimentation are key features here. Since high tech opportunities frequently are obscured by a veil of complicated technology, SPCSs that have a technical knowledge focus will be more effective in unearthing these opportunities. Expert input to the planning and control process is one way to facilitate this. Keeping the firm aligned with a highly dynamic environment requires an SPCS that enhances organizational learning. Systems promoting ***organicity*** and the free flow of information offer this type of enhancement. Avoiding chaos in a context of high dynamism, complexity, and uncertainty is possible when the SPCS effectively projects a unifying vision to organization members. Systems that emphasize and augment visionary leadership facilitate vision projection. Finally, SPCSs that rely more on corporate culture than on administrative formalism for behavior control will be

better able to rally a diverse, loosely-coupled organization and accommodate the fast pace of technological change.

Perspective Sigma: Technicalities of planning and control can be interpreted more explicitly at this level of thesis progress. Prime touchpoints of change involve shifts from formal structures to organic processes, and feedback to feedforward control mechanisms. These characterize a management behavior experiencing time-compression. The process is fluid, ill-structured, surrendering of principles, lending to expediencies. Sensing, cogitation, and response must occur in so tight a time space that the corporation appears to react from its autonomic nervous system, spontaneously, ill-prepared. High-speed communication and computing help to return these less-controlled responses to a more-controlled, intellect-driven state, but the casualty rate among high-tech corporations attests to continuing deficiencies. In some sense, rapid-paced high tech simply transcends human capability. Obligations to cognition, especially reflection, are not being met. The drive is towards physical hyperactivity (get very busy if you are not sure what to be busy at), or sensual motivation (if the brain must be left out, go with emotion, with intuition, from the gut). What is wisdom here? Slow the pace of society, rein in the emotional impetus to commerce, manage with right-brain cognition and sound structure. Given America's multinational corporation obligations, veritable kingdoms larger than nations to oversee, the task still is transcendent. Accordingly, appeal to the divine, the Mind of Christ, also is indicated. Only in God's provision to guard our pathway, maintain our righteousness without regret, can global service be delivered surely. Only in the harmless, gentle character of Christ can the power of high tech be administered and transferred to nations without abuse, without demotion by our own subsequent vulnerability.

William C. Patterson Ph.D.

Perspective Sigma.WMA

***Trust in the LORD**, and do good; so shalt thou dwell in the land, and verily thou shalt be fed. Delight thyself also in the LORD; and **he shall give thee the desires of thine heart**. Commit thy way unto the LORD; trust also in him; and he shall bring it to pass. And **he shall bring forth thy righteousness** as the light, **and thy judgment** as the noonday. Psalm:37.3-6 The **fruit of the Spirit** is love, joy, **peace**, longsuffering (patience), gentleness, goodness, faith, meekness (**restraint in the use of power**), temperance (**self-control**): against such there is no law. Galations:5.22-23 **Every good gift and every perfect gift** is from above, and cometh down from the Father of lights, with whom is **no variableness**, neither shadow of turning. Of his own will begat he us with the word of truth, that we should be a kind of firstfruits of his creatures. Wherefore, my beloved brethren, **let every man be swift to hear, slow to speak, slow to wrath**. James:1.17-19*

A survey of medium and large firms in the computer industry (SIC 357), electrical equipment industry (SIC 36), and instrumentation industry (SIC 38) largely confirms expectations regarding high technology strategic planning and control system attributes. The 34 firms participating in the survey report SPCSs with above-average integrative capability, risk accommodation, technical knowledge focus, organizational learning enhancement, vision projection, and corporate culture salience. All attributes are moderately correlated with key internal and external performance criteria except technical knowledge focus. The extent of permissible generalization about the technology orientation of SPCSs in high tech firms is that it may be a necessary qualifier for successful strategic decision making, but only policies of (1) including technologists from various specialties in the planning process, and (2) involving technologists with customers, benefit SPCS effectiveness. Largely **unconfirmed** by the survey analysis are

theoretical SPCS mandates to integrate suppliers with the firm, heighten competition among maturing projects, and frequently alter the organizational structure.

Affirmation of the six-item array of SPCS attributes as arena entry credentials and/or performance drivers in some high technology settings engenders a degree of optimism that similar configurations would be well-suited to any technology-intensive enterprise positioned in an environment loaded with complexity, dynamism, and uncertainty. The evident shift towards this type of business environment that is occurring generally also suggests that mainstream firms might benefit from adopting some of these features in their SPCSs.

Efforts to reveal the existence of a high technology SPCS typology based upon multi-industry survey data were moderately successful. A five-way classification was discernible and assigned the type descriptors: Technoreactors, Technopreneurs, Technogeneralists, Technovisionaries, and Technoplanners. Performance and process distinctions among the types indicate that there are relatively few extant departures from across-the-board pursuit of the prescribed SPCS ideals that also are beneficiaries of above-average performance. There is some evidence, however, that SPCS postures can become so technically driven that performance degrades below that of more conservative and less technically disposed systems.

A general lack of consensus regarding the definition of high technology enterprise prompted validation of the sample selection criteria used in this study, which emphasizes R&D intensity. Technology strategy operationalized by six variables depicting R&D policy, patenting policy, and plant & equipment policy was evaluated for performance effect and industry structure contribution. Analyses performed using Compustat data on 46 medium and large firms from the computer industry (SIC 357) confirms that the technological component of organizational strategy does indeed impact performance in this domain, particularly regarding sales expansion.

Technology strategy also contributes to industry structure through the creation of strategic groups having both strategy content and performance distinctions. Six strategic patterns were discernible which largely reflect trade-offs between initiators of competitive advantage (R&D intensity, relative patenting activity, and plant & equipment newness) and sustainers of competitive advantage (share of industry R&D, absolute rate of patenting, and depth of patent reserves).

Under the assumption that effective strategic planning and control systems are necessary to produce effective strategy, an attempt was made to demonstrate coalignment of strategic groups in the computer industry originating from both strategy process and strategy content bases. This effort was **not successful**. However, failure here does not invalidate the claim that content excellence is rooted in process excellence. The observed lack of congruity can be more properly attributed to specification conventions. Process

outputs used here (i.e., technology strategy) have both steady-state and cumulative properties. However, there are no cumulative property correlates in the time-independent process attributes used to characterize the SPCS. A more restrictive and unified specification regimen for strategy process and content properties might have resulted in greater isomorphism among the strategic group structures.

Chapter VIII
CONTRIBUTIONS AND LIMITATIONS

Most research projects are designed to advance knowledge and understanding, and both negative and positive hypothesis tests provide insights to reality. Positive results typically are more satisfying to the researcher, but negative findings stimulate further critical analyses. This study recorded mostly positive results regarding planned advances to strategic management theory, to analytical methodology, and to the body of practitioner knowledge, although future research still is needed. The following sections discuss these contributions, and conclude by identifying limitations to the study that the research design was unable to eliminate.

A. THEORETICAL CONTRIBUTIONS

This research contributes to the field of strategic management in various ways. Schendel and Hofer (1979) included strategic planning systems and strategic control among 18 areas in particular need of research to advance the field. They further encourage development of contingency theory for both, which this research does by isolating the high technology domain. The issue of evaluating planning system effectiveness also is raised. In this research, both internal and external perceptual measures are utilized. Finally, this dissertation is responsive to their call for research that integrates strategic planning and strategic control functions.

Summer et al. (1990) declare that the central focus of the field of business policy and strategy is comprehensive alignment, that is, alignment between the total organization and its relevant environment. This research deals with the central issue of alignment to the extent of assessing fit between strategic planning and control systems and their technological environments. The study also addresses three of the four dominant concepts of the field identified by Summer et al. (1990): environment, strategy, and performance.

The high technology environment can be regarded as a multidimensional environment since it exhibits extraordinary complexity, dynamism, and uncertainty. Past studies suggest that processes of strategic planning and control in such a setting are different from those in simpler, more stable, and relatively certain environments (Fredrickson, 1984; Fredrickson and Mitchell, 1984). Accordingly, high technology industries present one of the few opportunities to investigate these processes in a true, multidimensional context.

Perspective Tau: Strategic planning and control has had a programmatic tradition. Corporations believe that if they install a formal system of planning and control it will produce desirable outcomes by virtue of the protocol. In most cases, one need only specify what subject matter is appropriate for the plan (e.g., strengths and weaknesses, opportunities and threats, distinct competencies, critical success factors, etc.), and the collective cognitive power of the organization is able to fill out the plan, complete its intentions for information, and deduce its prescribed solutions. This research moves the planning and control process into a different, higher level of sophistication. New content is prescribed. Its nature is more process-enabling than fact-finding. Planning and control are the meta processes, but demanding subordinate processes, important new management responsibilities, are indicated for high technology performance excellence. The salient priorities for success this research identifies set new planning and control agenda. Establishing Integrative Capability, for example, evokes refined study of means, setting of formal objectives, measuring of performance, and correcting deviations. It becomes subject of the grand management process of planning, organizing, staffing, directing, and controlling. It assumes entity status, like an employee or production volume or cost. Much the same logic applies to other planning and control feed processes in the high technology environment: Accommodate risk, focus on technical content, enhance organizational learning, project vision, and administer organizational culture. This research yields but a few indices of successful development along these finer dimensions of high-tech planning and control. Further research will enrich the subject field, and practitioner experiences will yield pragmatic answers. The first tier of planning and control has installed a demanding superstructure. This second tier of planning and control, specific to the high-tech domain, installs humanizing, organic dimensions; real-time, experiential processes. To administrative refinement is now added behavioral refinement. It reaches to the human beings in the process and in the organization, while continuing to service the armor-plate of industrial organization performance. With added Christian Perspectives, there is investment in yet another layer of sophistication. Divine qualities augment the human dimensionality. **Christ-centering** affords greatest insurance for risk accommodation, taps the mind of God in cogitating technical complexity, learns things elusive and unseen via heavenly wisdom, draws from prophetic power for vision projection, and rounds out the character of Christ in composing corporate culture. In Christ emerges the third, final tier, the **Spiritual Frontier**, crown of knowledge and power and glory.

William C. Patterson Ph.D.

Perspective Tau.WMA

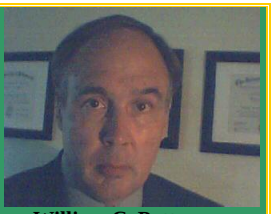
*All things were made by him; and **without him was not any thing made** that was made. In him was life; and the life was the light of men. John:1.2-3 As many as received him, to them gave he power to become the sons of God, even to them that believe on his name: John:1.12 Forasmuch then as **we are the offspring of God**, we ought not to think that the Godhead is like unto gold, or silver, or stone, graven by art and man's device. Acts:17.29 **In him dwelleth all the fullness of the Godhead bodily**. And ye are complete in him, which is the **head of all principality and power**: Colossians:2.9-10*

Schoonhoven (1984) calls attention to the rather widely-held belief that planning and control formality is detrimental to managing high technology businesses. However, Schoonhoven (1984), Bahrami and Evans (1989), and Jelinek and Schoonhoven (1990) show that there is a discernable structure and systematicity to strategic management in high technology firms. This research extends these earlier efforts to reveal what might be designated as **lower-level order** in management systems. According to this concept,

strategic planning and control systems are investigated not only in terms of their specific administrative context (the formal system), but also in terms of a broader organizational context of purposed or *de facto* strategic planning and control (the semi-formal system). It is in this expanded domain where culture-based control, management as experimentation, technical knowledge transfer, etc., are found to operate. The **semi-formal system** may well be the key to studying and understanding strategic planning and control in these kinds of firms and in these kinds of settings.

B. METHODOLOGICAL CONTRIBUTIONS

Perspective Upsilon: One methodological contribution of this work rises higher than others: Use of graphical, 1-to-3-dimensinal representations of strategy and industry. In the Information Age, we are blessed with abundant data to feed our understanding. However, powerful statistical methods and computers for rapidly calculating statistics now produce summary information in overabundance. The mind is sorely taxed to absorb the wealth of primary data reduction or abstraction. One might liken the contrast to that between reading instrument displays in an automobile versus reading those in aircraft or spacecraft. Accordingly, the abstracting power of statistical analyses needs to progress further than voluminous numerological summaries. A secondary processing into the graphical domain is generally needed. The left brain is thereby enabled to grasp via gestalt what the right brain labors to know. Strategy is the generalizing discipline in management, the harbor of conceptual thinkers and abstract decisionmakers. To keep the Rational Model of management alive, it must not become mired in numerical excess. Rather, setting the endpoint for sophisticated analyses to a graphical forma brings near instantaneous recognition, gracing the always-important, divinely-mastered reflection and sense-making finale. Pictures well-composed mirror reality, seeming to speak an instant language of enlightenment. This dissertation promotes new graphical concepts of Strategy Maps and Strategic Group Maps, putting the whirl of nearly incomprehensible high tech dynamism, complexity, and uncertainty within easier grasp.



William C. Patterson Ph.D.

Perspective Upsilon.WMA

*The **wisdom that is from above** is first pure, then peaceable, gentle, and **easy to be entreated**, full of mercy and good fruits, without partiality, and without hypocrisy. James:3.17*

An attempt has been made in this dissertation to be responsive to many of the methodological priorities for meaningful research in the strategy field. Jemison (1981) calls for research that is integrative, particularly in relation to content and process. Although this study is primarily process oriented, strategy content is addressed (hypotheses 1, 2, and 5). Daft (1983) and Jick (1979) encourage side-by-side use of quantitative and qualitative approaches. Whereas the greatest part of this study is quantitatively oriented, allowance was made for qualitative input via free and open comment on the questionnaire. This kind of unstructured information could have been quite valuable in understanding aspects of the strategic planning and control process not suggested by the literature or objectively collected. The absence of substantive feedback here helps to affirm content validity of the survey instrument and raises confidence about comprehensiveness of the study.

Harrigan (1983) calls for the use of hybrid research methodologies to bridge the gap between fine-grained case studies and course-grained analyses based on massive databases. She encourages use of multiple data sources, more selective sampling, and classificatory analytical methods among other refinements. Use of multiple secondary data sources coupled with primary data gathering, confinement of sampling to high technology firms, and use of cluster analysis, collectively make this research effort responsive to the precepts of *hybrid methodology*. Snow and Hambrick (1980) also recommend use of multiple data sources and identify self-typing and objective indicators, the measurement approaches used here, as appropriate alternatives. The emphasis given to construct development is responsive to another research priority identified by Venkatraman and Grant (1986), Fredrickson (1983), and Snow and Hambrick (1980).

Perhaps novel among the methodological contributions of this study is use of a simple but effective technique for *comparing strategic group structures*. Beyond its obvious usefulness in cross-sectional studies of this type, the technique could benefit and encourage more longitudinal studies of strategic groups, another research priority (McGee and Thomas, 1986). Finally, the use of Strategy Maps and Strategic Group Maps can be viewed as responsive to the tenets of holistic research (Jick, 1979). They help to produce a highly coherent picture of content or process knowledge beyond that revealed by hypothesis testing.

C. PRACTICAL CONTRIBUTIONS

Perspective Phi: High technology enterprise qualifies as management at the experimentation frontier, mastering the power of knowledge. The most advanced domain regarding speed and sophistication, generation and exhaustion of wealth, restraint and abuse of power, it clearly tests great societies along the moral path to greatness. Issues being decided by the high priests of this flock include: Should we sprint to exhaustion or run a well-paced race? Should we generate money as fast as we can, regardless of liabilities of newness littering the path with expensive hazards and organizational casualties? Should hyper R&D be allowed to propel all products into premium price ranges, limiting the technology dividend to customers? Business administration knows more than the rules of engagement in the high tech arena. It has power to choose administration pace and character. The fathers of these special enterprises can lead according to paternal wisdom or surrender to youthful extremism, run an orderly house or release a whirlwind of shambles. Real control isn't learning to desperately chase success in a hurricane of crosswinds. Planning and control wisdom looks above the fray to setting the overarching human and moral and spiritual dials and buttons correctly. The thesis as originally published addresses the finer grain of whirlwind management. The embellishing commentaries of this issuance address the coarse-grained, over-arching, abiding concerns of good management, well-harmonized with Godly character and Kingdom order.

William C. Patterson Ph.D.

Perspective Phi.WMA

*Seek ye first the **kingdom of God**, and **his righteousness**; and **all things shall be added** unto you. Matthew:6.33*

High technology industries are a vital part of the nation's economy and occupy a prominent, highly-challenged position in the global marketplace. They also are among the least-developed arenas regarding strategic management principles. Since this research helps to expand the knowledge base for strategic planning and control in high technology firms, it contributes to their competitiveness in international markets and helps to reduce the exceptional riskiness of managing these kinds of firms.

This dissertation attempts to synthesize what is known about strategic planning and control systems, strategic management of technology, and industry-specific behavior in such a way as to distill for the practicing manager some valid principles for succeeding in this type of business. In particular, it should guide him into configuring a system for strategic planning and control that is effective along several critical dimensions, and which charts a prudent course between formal and informal operating mechanisms.

The major lesson that this research brings to practitioners can best be summarized by answers to three direct questions:

What is high technology?

Although the following discussion may not settle definitional issues for academic research, results of this study permit some observations about the concept of high technology that can be very useful for practitioners. The economic data on high technology industries clearly indicate that these are areas of high opportunity. Hypotheses 1 and 2 indicate that investment in technology is the key to tapping these opportunities. Metaphorically, high technology firms are miners tapping a rich gold vein using shovels sized according to the level and quality of each firm's technological investments. Finding that vein means looking for business where **(1) reasonable technology investment bring significant product/process improvement, (2) natural or commercial limits to these improvements have not yet been reached, and (3) these improvements directly respond to important user needs.** Industries or industry segments meeting the above criteria are fertile areas of opportunity, even if they currently do not carry the label "high technology."

A few examples substantiate the above. Reasonable technological investments have shrunk size and raised processing speed of computers by several multiples in recent years, directly benefiting users via task productivity and quality improvement. There is strong linkage between cost-efficient technical improvement and need fulfillment. On the other hand, it does not appear likely than any reasonable technology investment will improve steel by comparable magnitudes, even though improvement in strength, corrosion resistance, formability, and manufacturing cost continue to be made. The linkage between technical effort and need fulfillment in the latter case is relatively weaker at this point in history.

A *radical innovation* could rejuvenate the mature technology of the steel industry into a *de facto* high technology opportunity. However, the low level of research expenditure in that industry suggests that few business people believe such a discovery is very probable. This should not be construed to mean that advances like direct reduction ironmaking and other worthy technical programs are not individually good investments.

What strategy best develops high technology opportunities?

As indicated earlier, technological investment is an important avenue to success in high technology industries. **Investments in modern equipment and investments in R&D that produce an ever-increasing stream of proprietary technology maximize returns and shareholder benefit. Pursuing the goal of R&D share growth and share leadership is the key to long-term, large-scale profits and superior market positioning**.

From a structural perspective, the **best strategy involves finding a niche with great potential for technological exploitation and establishing a protective wall of proprietary technology to secure the organization's position**. This is what successful firms like Cray Research, Tandem Computers, and Sun Microsystems have done in the computer industry, although Cray's position has been weakening recently. Since the availability of these niches may be limited, blending technological strengths with exceptional marketing skills also appears to be effective. Firms like Dell Computers and Tandy have prospered with this type of strategy in the computer industry.

The generic strategic of diversification does not appear to be particularly rewarding in high technology industries. While it does seem to be the key to long-term growth and prominent industry positioning, small firms with a differentiated position often perform better. Difficulties that companies, like IBM, DEC, UNISYS, and others have had in the computer industry provide support for this observation. Remaining on the cutting edge of technology as a large, diversified organization may be extremely difficult, a conjecture that underscores the importance of effective strategic planning and control in older and larger firms. This leads to the final question:

What system is best for strategic planning and control?

From a planning and control perspective, the two most important things firms in a high technology setting can do to succeed are **(1) configure their SPCSs to facilitate organizational learning and (2) see that the SPCS vitally links the organization with its environment while effectively integrating the major internal specialties**. The fast pace of change sharply discount the value of aging information and forces firms to continually test their environments, strategies, and general organizational posture for congruence according to current or anticipated information. This changing information

flow demands open conduits for communication among marketing, manufacturing, engineering design, R&D, technical planning, technology forecasting, and strategic planning to facilitate directional change and to coordinate organizational units.

Of almost equal importance to the above is a **SPCS that projects a well-defined vision of success and establishes appropriate motivational apparatus to keep organizational members taking risks to fulfill that vision**. Technical complexity prompts an organizational arrangement wherein members often exercise individual discretion in choosing means, but discipline their choices according to criteria established by the firm's vision.

A **strong corporate culture that fosters openness and trust** also is important for planning and control. These shared values facilitate information flow and avoid the slowing effect on change that formalized systems can bring. They also reinforce attitudes regarding risk-taking and individual responsibility that underpin success.

While a technological orientation to information flow and decision-making in the SPCSs found in high technology firms may be common, only a few policies having technical focus appear to enhance SPCS effectiveness. High technology firms should reap benefits from **involving technologists with customers**, and may find it helpful to **involve technologists from various technical specialties in the planning process**.

Performance levels associated with prominent SPCS types found in the study prompts a **cautionary footnote** to the previous guidelines. One of the less desirable SPCS configurations that may be easy to assume involves overemphasizing technological dimensions of the firm's vision for success. Apparently, **firms can become so technically driven that commercial aspects are discounted and performance suffers**.

D. LIMITATIONS OF THE RESEARCH

Most of the limitations of this study relate to survey research issues. Ideally, more than a single respondent to the questionnaire should have been targeted from each organization. This might have increased the total responses. It also would have helped to moderate the effect of personal bias and to give a more complete view of the complex and wide-ranging aspects of strategic planning and control within each firm. Multiple responses, however, can be problematic. Most significant is the potentially adverse reaction of busy executives who find they are collectively duplicating the same questionnaire. Also relevant is the problem of adequately synthesizing a firm's individual response from multiple responses.

Another deficiency introduced by the adoption of survey methodology is the likelihood of a self-selection bias. The survey sample may not be truly representative of high technology firms in general. Rather, it may represent that subset of high technology

firms who more closely conform to the *de facto* norms of the instrument. While it is difficult to control for this type of behavior, the lack of anomalous results in tests that were conducted for non-response bias suggests that this factor should be a rather limited cause for concern.

Perspective Chi: This re-release of my original, 1992 thesis is augmented by several commentaries from a Christian perspective and seasoning by 13 additional years of experience. While those who originally directed my work kept me from most research pitfalls and unhappy endings, the doctoral process at top business schools of our nation does not really accommodate perspectives from the Christian faith. This is a glaring omission for several reasons. First, as our Pledge of Allegiance clearly states, we are a nation under God, and should be able to invest His values in all that we do. Academically, those who purport to know the highest things of knowledge and wisdom cannot complete their philosophy or scholarship or teaching without explicitly dealing with the God who created all things for His good pleasure. Understanding cannot be complete without explicating His role adequately. Finally, there is the human dimension of life and society that knowledge workers are expected to serve, now with greatest effect than ever. If one does not know the Lord as the way, the truth, and the life, he can so easily miss the central truth that only gentlemen successfully wield infinite power, and that they ideally do so with loving kindness and tender mercy. I am pleased to re-compose this document, setting right its central limitation. I trust that God, indeed, now has the last word in this work, to His glory.

William C. Patterson Ph.D.

Perspective Chi.WMA

Trust in the LORD with all thine heart; and lean not unto thine own understanding. ***In all thy ways acknowledge him****, and he shall direct thy paths. Proverbs:3.5-6 Jesus saith unto him,* ***I am the way, the truth, and the life****: no man cometh unto the Father, but by me. John:14.6* ***It is God which worketh in you both to will and to do of his good pleasure****. Philippians:2.13*

Financial and time limitations mainly were responsible for the selection of mailed questionnaires as the method of primary data collection. Objectivity also was a factor. However, interviews with firm representatives possibly could have eliminated the inevitable attrition of sample size associated with mailed questionnaires, precluded self-selection bias, and allowed for more extensive exploration of the interplay between strategy process and content issues in the computer industry.

The use of perceptual data creates the possibility for personal bias to contaminate the data. This tends to cancel out as sample size grows. Despite its shortcomings, this mode of data collection has been the cornerstone of research on systems for strategic planning and control.

The caveat mentioned in connection with targeting high technology firms did have an effect on both subsamples used in this study. Using industry, rather than product, classification bases for identifying high technology firms did introduce some "lower-tech" sample constituents. This slight erosion of sample representativeness was tolerated for two reasons. The smallness of available samples for studying high technology firms makes it unattractive from a statistical perspective to discard marginal data and lose already precious degrees of freedom without compelling justification. More importantly,

however, the "lower-tech" constituents magnify the effect variance among measured variables. This heightened contrast increases the likelihood of effects being identified in statistical tests.

The operationalization of performance also qualifies as a limitation of this study. The factors chosen do not fully satisfy the criteria proposed by Chakravarthy (1986). Notably missing are measures of stakeholder affirmation, a measure of effectiveness that is growing in significance (Kanter, 1981). This kind of information is only sparsely available currently and, therefore, was excluded form the study. As stakeholder concerns become more definitive, future research should be able to consider such criteria. *A posteriori* recognition that nonfinancial measures figure prominently in performance assessment of high technology firms also points up a lack of richness in the characterization of performance.

The prominence given to assessing performance consequences also might be viewed as a limitation of this study. Chakravarthy (1987) contends that the link between strategic planning system variables and financial performance is so laden with complexities that only user ratings of system effectiveness are practical measures of performance. The present research design optimistically tested for the financial performance connection, but additionally included ratings of effectiveness and user satisfaction in the array of performance measures. Similarly, Lewis and Thomas (1990) question the value of testing for performance differences among strategic groups because many researchers fail to observe significant differences. This research design optimistically tested for performance differences among strategic groups, but additionally assessed performance differences at the level of the individual firm.

Finally, the present research is narrower in scope than might be desired. The computer industry has become internationalized and North American firms now confront major international competitors such as Siemans, Olivetti, Hitachi, and Samsung. A study of international dimensions might be a natural follow-up to the present effort, however, internationalization of the present research design would have introduced cross-cultural factors relating to management style, workforce attitudes, economic systems, etc., that might have had a confounding effect on results (Snodgrass and Grant, 1986). American leadership in most areas of computer technology continues to be recognized worldwide, so the present focus should yield the best guidelines for strategic planning and control from a U.S. perspective.

APPENDIX A

Appendix A

SENIOR EXECUTIVE QUESTIONNAIRE

Strategic Planning and Control Systems in High Technology Firms

John H. Grant
Professor and Director
Strategic Management Institute
412/648-1707

William C. Patterson
Project Director
412/243-3244

Joseph M. Katz Graduate School of business
University of Pittsburgh
Pittsburgh, PA 15260

PROJECT DESCRIPTION AND GENERAL INSTRUCTIONS

High technology firms operate in environments of complexity, dynamism, and uncertainty unmatched by most other categories of business. Such environments place great demands on their corporate systems for strategic planning and control. Unfortunately, existing guidelines and literature often provide conflicting advice regarding the best techniques and systems to accommodate these environments. The aim of this research is to ascertain general management principles that will help high technology firms such as yours to manage these systems more effectively. The information you supply in this questionnaire will be extremely valuable in discerning the most important strategic planning and control system attributes and establishing their linkage to corporate performance.

For the purpose of this questionnaire you should conceptualize your strategic planning and control system in terms broader than just administrative procedures and document flows. Consider all formal and informal means intentionally and regularly invoked or managed to facilitate strategy formulation and keep the firm's strategy producing the desired results.

The questionnaire should be filled out by a senior executive who has had substantial familiarity with all of the firm's operations as well as its business environment over the past five years. Respondents from diversified firms should give answers which reflect only the high technology segment of their organization. **Please answer every question** because incomplete questionnaires severely impair data analysis. Feel free to make additional comments by a particular question or at the end of the questionnaire. Most questions require you to enter a single number depicting your position on a scale ranging from very low or none (indicated by a "1") through very high (indicated by a "7"). Your response should indicate things as they "actually are" rather than the "desired" or "ideal" situation. You should be able to complete the survey in **about 15 minutes.**

The information you provide will be treated as strictly confidential. In no instance will a particular individual or organization be identified as having made a particular response. Data from participating firms will be pooled and only aggregate results will be reported. A postage-paid envelope is included for your convenience. If you have any questions, please fell free to call either party identified on the questionnaire cover. In return for your participation in this study, you will receive an executive summary of the completed research project. Thanks in advance for you valuable assistance!

Please characterize the way your organization formally and informally conducts the process of strategic planning and controlling in each of the six areas below. Rate each item BY NUMBER according to the following scale:

Response Scale						
1	**2**	**3**	**4**	**5**	**6**	**7**
Very Low or None	Low	Low to Moderate	Moderate	Moderate to High	High	Very High

INTEGRATIVE CAPABILITY

With what degree of effectiveness does your current strategic planning and control system (SPCS) enable the following organizations, functions, groups, and activities (items 1-7) to work productively together to influence and implement strategy?

Rating	Indicant	Deciding Issue
	1	Customers interacting with the firm
	2	Suppliers interacting with the firm
	3	Marketing interacting with R&D
	4	Engineering interacting with manufacturing
	5	Operations management interacting with strategic planning
	6	Technology forecasting interacting with strategic planning
	7	Technical planning interacting with strategic planning
	8	What level of use is made of *ad hoc* interdisciplinary groups (committees, teams, task forces, project groups, etc.) in supporting the strategic planning and control effort?
	9	To what degree do informal information sharing meetings contribute to strategy formulation?
	10	What level of use is made of technology portfolio concepts in your SPCS?
	11	To what degree do you identify and use concepts like “distinct technological competencies” or “strategic technical areas” in formulating strategy?
	12	With what effectiveness does your SPCS make you aware of the needs of important stakeholders (customers, suppliers, etc.) in your firm’s external environment?
	13	With what effectiveness does your SPCS blend the inputs of technical and marketing functions within your firm to formulate and implement strategy?

Response Scale						
1	**2**	**3**	**4**	**5**	**6**	**7**
Very Low or None	Low	Low to Moderate	Moderate	Moderate to High	High	Very High

RISK ACCOMMODATION

Rating	Indicant	Deciding Issue
	14	What degree of influence do entrepreneurial/intrapreneurial managers have on the SPCS?
	15	What degree of influence do product/process "champions" have on the SPCS?
	16	To what degree does your incentive system foster risk-taking?
	17	What portion of the incentive compensation in your organization is geared to rewarding long-term output?
	18	What degree of protection from financial or career adversity is afforded risk-takers who experience failure?
	19	To what degree is seed money available to start new technology projects of an experimental nature?
	20	To what degree are parallel technology projects pursued to cut the risk of failure in key areas?
	21	To what degree does competition among technology projects escalate as funding requirements enlarge?
	22	To what degree does is risk on major projects shared among many people, including the CEO?
	23	How would you rate your firm's ability to operate effectively in a risky business environment?
	24	What degree of business risk is your organization regularly willing to take?
	25	What degree of technical risk is your organization regularly willing to take?

Response Scale						
1	**2**	**3**	**4**	**5**	**6**	**7**
Very Low or None	Low	Low to Moderate	Moderate	Moderate to High	High	Very High

TECHNOLOGY KNOWLEDGE FOCUS

Rating	Indicant	Deciding Issue
	26	To what degree is top management's background technically oriented via formal education or R&D, engineering, or manufacturing experience?
	27	To what degree does top management practice a "hands-on" management style?
	28	What diversity exists in technical background among technical personnel contributing input to the strategic planning and control effort?
	29	What is the depth of technical background among technical personnel contributing input to the strategic planning and control effort?
	30	To what degree do technologists interact with customers?
	31	To what degree does the firm pursue joint ventures, consortia, academic research, and related external relationships to realize technological benefits?
	32	How would you rate the technical competence of the top management team?
	33	To what degree do issues of manufacturing strategy (quality improvement, simultaneous engineering, computer integrated manufacturing, etc.) impact the strategic planning and control process?

Response Scale						
1	**2**	**3**	**4**	**5**	**6**	**7**
Very Low or None	Low	Low to Moderate	Moderate	Moderate to High	High	Very High

ORGANIZATIONAL LEARNING ENHANCEMENT

Rating	Indicant	Deciding Issue
	34	How responsive is your SPCS to changing customer needs?
	35	How likely is our SPCS to facilitate opening "windows" on new technology so its potential utility for your firm may be explored?
	36	How do you rate your firm's effectiveness in managing transitions from old technology to new technology?
	37	To what extent does your SPCS foster a "small company" environment through simple procedures, limited rules, reliance on interpersonal contact, and generally reduced formality?
	38	With what degree of precision does the organization know if it is not performing up to expectations?
	39	With what frequency is the organization's structure modified to facilitate strategic change?
	40	To what extent do you "experiment" in exploring new strategic directions for your firm?
	41	To what degree are technology projects selected in an open, systemic manner/
	42	To what degree is decision making free from internal "politics"?
	43	How would you rate your organization's ability to react to environmental change (new competitor products, new competitors, new technical developments, etc.)?
	44	How flexible is your organization (are structural adjustments readily accepted)?

Response Scale						
1	2	3	4	5	6	7
Very Low or None	Low	Low to Moderate	Moderate	Moderate to High	High	Very High

VISION PROJECTION

Rating	Indicant	Deciding Issue
	45	How effective are the corporation mission and upper-level objectives in conveying top management's vision for success to the organization?
	46	To what degree are low-level objectives left vague to allow discretion in fulfilling the corporate vision?
	47	To what degree does the strategic control system allow patience in letting results materialize?
	48	How effective is top management in communicating their vision for success to the organization?
	49	To what degree is the organization driven by top management's vision for success?

Response Scale						
1	**2**	**3**	**4**	**5**	**6**	**7**
Very Low or None	Low	Low to Moderate	Moderate	Moderate to High	High	Very High

CORPORATE CULTURE SALIENCE

Rating	Indicant	Deciding Issue
	50	To what degree is employee behavior influenced by the values, attitudes, and beliefs shared by the organization (as opposed to formal rules, regulations, policies, etc.)?
	51	To what degree does your corporate culture attract and nurture creative employees?
	52	To what degree does your corporate culture nurture openness and trust, communication, cooperation, participative decision-making, and concern for employee welfare?
	53	What is the extent of your agreement with the statement: Our organization is driven by a strong, positive corporate culture?
	54	To what degree does top management try to nurture and "manage" the corporate culture of your organization?

Response Scale						
1	**2**	**3**	**4**	**5**	**6**	**7**
Very Low or None	Low	Low to Moderate	Moderate	Moderate to High	High	Very High

PERFORMANCE

Rating	Indicant	Deciding Issue
	55	How would you rate overall effectiveness of your strategic planning and control system?
	56	Relative to other firms in our industry, how do you rate your financial performance?
	57	Relative to other firms in your industry, how do you rate your stock price performance?
	58	What is the degree of satisfaction among top management with your firm's system for strategic planning and control?
	59	To what extent are non-financial measures of performance (on-time delivery, defect rates, market share, employee turnover, etc.) considered by top management in strategic planning and control activities?

OTHER DESCRIPTIVE INFORMATION (record actual value or information)

Value	Indicant	Deciding Issue
	60	Give approximate length of the strategic planning document in pages.
	61	How frequently (in years) does top management conduct a complete review of the organization's strategy to update the strategic plan?
	62	How many years have you been with this organization?
	63	About how many years has your strategic planning and control system been functioning the way you have described it in this questionnaire?

What is your title?

If there are any distinctive characteristics of your system for planning and controlling not yet addressed which you feel significantly influence your firm's overall performance, please elaborate below or attach your comments.

THANK YOU FOR YOUR COOPERATION!

If you would like to receive the Executive Summary, please furnish your **name and address** below or send a separate request:

COMMENTS

SAMPLE COVER LETTER

January 15, 1992

Mr. John A. Smith
Director of Strategic Planning
ABC Company
123 Main Street
Anywhere, U.S.A.

Dear Mr. Smith:

High technology enterprises are assuming a role of considerable importance in our domestic economy and in international trade. Yet high tech firms have not had the benefit of enough research to determine why certain management systems and procedures fail to perform adequately in the dynamic business environments they face.

We are engaged in a research project to study systems for strategic planning and control in high technology companies. This work should yield benefits for corporate executives such as yourself who daily confront the uncertainties of managing in this challenging domain. We are concentrating on identifying important formal and informal attributes of strategic planning and control systems and determining how they influence organizational performance. Your input will greatly benefit this research.

Please complete the attached questionnaire and return it in the enclosed postage-paid envelope. This should take about 15 minutes of your time. All replies will be treated as **strictly confidential**, and results will be aggregated to conceal individual responses to any question.

If you feel that one of your colleagues would be a more appropriate respondent to this study, please forward the questionnaire to him/her. Should there be any questions, please call either of us at the number shown on the questionnaire cover. As an expression of our appreciation for your cooperation, we would like to send you an Executive Summary of the completed research. Thank you very much for your valuable time and input!

Sincerely,

John H. Grant
The Robert Kirby Professor of Strategic Management
Director, Strategic Management Institute

William C. Patterson
Project Director
412/243-3244

enclosure

SAMPLE FOLLOW-UP LETTER

February 12, 1992

Mr. John A. Smith
Director of Strategic Planning
ABC Company
123 Main Street
Anywhere, U.S.A.

Dear Mr. Smith:

A few weeks ago we mailed you a questionnaire as part of a research project to study strategic planning and control systems in high technology firms. Since that time we have received a number of helpful responses. Unfortunately, your response has not yet reached us.

Please know that we genuinely need your contribution to this project to better understand the important issues of planning and control in this critical domain. We are confident that it will yield results that firms such as yours will find helpful.

If you have already returned the questionnaire and it has not yet gotten to us, please accept our thanks for your cooperation and disregard this letter. In the event you need another questionnaire, please let us know by letter or phone and we will gladly supply a replacement.

Thank you again for your willingness to contribute to this research.

Sincerely,

John H. Grant
The Robert Kirby Professor of Strategic Management
Director, Strategic Management Institute

William C. Patterson
Project Director
412/243-3244

APPENDIX B

DESCRIPTION OF THE COMPUTER INDUSTRY

(1985-1989)

Although other high technology industries also are examined in this research effort, the computer industry serves as the centerpiece. The research design does not require completion of comprehensive industry analyses in order to fulfill its purpose, however a certain amount of background information on the focal industry gives this work a context that makes the results more meaningful. An attempt is made here to identify some of the prominent players in the computer industry and notable industry segments. Major product categories and core technologies also will be explicated to a limited degree. The aim is to acquaint the reader with some of the important dimensions of high technology without delving into technical minutiae. Additionally, aggregate data of an economic nature will be presented to permit assessment of industry activity levels and evolutionary progress.

Two reputable literature sources that are widely used in the conduct of industry analyses form the referential foundation for material presented in this section. Standard and Poor's Industry Survey (1985-1990) and U.S. Industrial Outlook (1985-1990) are liberally paraphrased. Because so much of what is reported in these overlapping publications is diffusely available in the public domain, and in order to avoid unnecessary repetition of citations, no attempt will be made to cite the many individual uses of these two publications. However, when information is drawn from original sources named by these publications, the original source will be identified. All other literature sources employed will be cited in conventional fashion.

The market research firm of International Data Corporation (IDC) classifies product offerings in the computer industry in the following way. Large-scale systems, often called mainframes, are computer that cost more than $1 million and support more than 128 users. Included in this category are supercomputers, which are defined as the most powerful computers available at any time. These carry a price tag in the $2-$20 million range. Medium-scale computers encompass superminicomputers and small mainframe computers. They typically are priced in the $100,000 to $1 million range and support 17-128 users. Small-scale systems include minicomputers and supermicrocomputers. They range in price from $10,000 to $100,000 and support 2-16 users. Finally, the microcomputer or personal computer sells in the under-$15,000 range and supports a single user.

Rapidly changing technology is tending to cause overlap among these product categories. Also, new categories are coming into prominence. For example, workstations are high-performance single-user systems with advanced graphics capabilities that have focused thus far on scientific and engineering applications. Fault-tolerant computer systems have emerged in the mainframe and superminicomputer categories. They have hardware and

software redundancies to flawlessly handle critical applications employing on-line transaction processing (automated teller machines, reservation systems, inventory control, etc.). Another recent trend has been the emergence of minicomputers for those who need near-supercomputing power at a lower price. In the microcomputer category, growing interest in portability has taken the form of compact laptop and notebook computers. Finally, multiprocessing computers (those with more than one microprocessor) have begun to appear which offer better price/performance tradeoffs than traditional minicomputers.

International Business Machines Corporation (IBM) dominates the market for mainframe computers, holding a 70%-plus market share over the past several years. The 3090 mainframe introduced in 1985 has been its premier product line, however a successor, code-named *Summit*, is due in the early 1990s. UNISYS Corporation and Control Data Corporation are contenders in this mature market whose shares have been declining. Most of IBM's competition has come from plug-compatible manufacturers, such as Amdahl Corporation, who offer products compatible with IBM equipment that also have certain performance advantages.

Cray Research Incorporated is the dominant force in the supercomputer market. It was restructured into two companies in 1989. Cray Computer Corporation will develop the CRAY 3 supercomputer under the direction of Seymour Cray, founder of Cray Research. Cray Research will continue supporting existing product lines (CRAY-2, X-MP, and Y-MP) and pursue new developments. Key players in the minisupercomputer market include pioneer Floating Point Systems Incorporated and Convex Computer Corporation, their current leader.

IBM and Digital Equipment Corporation (DEC) are prominent in the medium-scale computer segment. IBM's offerings include 43XXs, 9370s, System/38s, and AS/400s. A new series of VAX superminicomputers introduced in 1986-97 was particularly well received, strengthening DEC's position in this category. Other notable contenders include DATA General Corporation, Prime Computer Incorporated, and Wang Laboratories Incorporated.

IBM and DEC also are leaders in the category of small-scale systems. Here, low-end VAX computers from DEC and IBM's System/36 are front runners. Other contenders include Altos Computer Systems, NCR Corporation, Hewlett-Packard Company (HP), Data General Corporation, and Wang Laboratories Incorporated.

Two companies are prominent in the manufacture of fault-tolerant computers: Tandem Computers Incorporated and Stratus Computer Incorporated. The latter supplies IBM with the System/88 fault-tolerant computer which it resells.

IBM has dominated the personal computer market, first with the PC, and more recently with the PS/2 line of microcomputers. Among competitors offering systems compatible with IBM microcomputers, Compaq Computer Corporation is a leader. Apple Computer Incorporated is the leading supplier of systems not compatible with IBM standards.

Three vendors dominate the workstation market. DEC, HP, and Sun Microsystems Incorporated account for about 80% of the business. HP's position was reinforced by the purchase of Apollo Computer Incorporated in May 1989. Silicon Graphics Incorporated is a leader in 3-D graphics workstations.

Although many firms are testing the waters in the portable computer market, the current leaders appear to be Compaq, Nippon Electric Company (NEC), Tandy Corporation, Toshiba, and Zenith Data Systems.

Compaq is one of the manufacturers of microcomputers who has offered a multiprocessing micro to challenge the traditional minicomputer makers. Their Systempro employs two central processing units supplied by Intel Corporation.

According to IDC of Framingham, Massachusetts, worldwide shipments of large-scale computers systems from U.S. manufacturers increased from $17 billion in 1985 to $20.9 billion in 1989. This segment has been shrinking as a percentage of total computer shipments, giving way to smaller computers whose capabilities have been growing dramatically. Fierce price competition now characterizes this segment as its role is being redefined. It is likely that mainframes will function increasingly as data repositories accessible via networks by a diverse host of smaller machines.

Shipments of supercomputers reached a level of $1.3 billion in 1989. The investment banking firm of Hambrecht and Quist estimated shipments of about $425 million in 1985. Lazou (1988) pegs the annual demand for these sophisticated computers at 30-50 machines per year. Only about 80 installations in the Western world possess one or more supercomputers.

For 1985, IDC estimated the worldwide shipments of medium-scale computers at $14.6 billion and small-scale computers at $12.3 billion. By 1989, combined shipments in these two categories (more recently referred to as mid-range systems) totaled $19.6 billion. This segment has been caught in the crunch between more price-competitive mainframes and increasingly capable microcomputers.

In the middle 1980s, IDC reported the microcomputer market to be about $17 billion. By 1989, the market grew to more than $28 billion. Dataquest, a consulting firm from California, projects that desktop personal computers will account for over half the total value of all U.S. computer shipments in 1990.

The workstation component of the microcomputer market which Apollo computer inaugurated n 1981 accounted for $6.4 billion in shipment value in 1989. This is up from $1.5 billion in 1986, and the market is projected to continue rapid growth. Portable computers reached a market value of $3.7 billion in 1989 according to Dataquest, Incoporated. The market was reported to be $834 million in 1985 by InfoCorp.

The technology of the computer industry is probably best appreciated by considering the performance capabilities of modern machines. One widely-used measure of a computer's performance is the number of instructions it can carry out in one second. Instructions vary in length so this criterion is influenced by the specific mix of instructions executed and is, therefore, subject to variation. Nevertheless, a modern microcomputer is able to execute about 5 million instructions per second (MIPS). This approximates the power of large and expensive mainframe computers sold slightly more than a decade ago.

At the other end of the spectrum is the supercomputer. Because these machines are built for their number-crunching capability with negligible text processing, a slightly different criterion is applied. Performance usually characterized in terms of millions or billions of floating point operations per second (termed megaflops or gigaflops). A floating point operation is addition, subtraction, multiplication, or division of floating point (decimal) rather than integer numbers. For scalar processing (such as adding two numbers to get a single sum), supercomputers are not vastly different in performance from a modern mainframe computer. For vector processing (such as adding two arrays or numbers to get an array of sums), supercomputers use special techniques such as pipelining (instructions can be executed step-wise, as in an assembly line) and parallel operations to achieve phenomenal results. For example, at peak capacity, a Cray-2 supercomputer can achieve 1.8 gigaflops (Lazou, 1988). The Cray-3 is being designed as a 15-gigaflop machine.

Modern computers embody many different technologies, and tradeoffs among these are a key source of industry competition. Accordingly, it is very difficult to select or propose the most significant core technologies for discussion here. At the highest level of generality, it is probably safe to claim that the silicon chip is most responsible for revolutionizing computer architecture (Lazou, 1988). Large scale integration made it possible to reduce miles of wiring and huge circuit boards to a small chip less than an inch square. The integrated circuit enables lower-cost fabrication, more compact design, lower energy utilization, greater reliability, and higher speed.

The microprocessor is at the heart of modern computer systems. It controls the interpretation and execution of instructions. Complex instructions set chips (CISCs) containing hundreds of built-in instructions have dominated modern microprocessor designs. However, reduced instruction set chips (RISCs) are growing in popularity, appearing on about one-fourth of the workstations shipped in 1989. In RISC machines, roughly 80% of the instructions usually built into the microprocessor are omitted. Only the most frequently used instructions remain in the simplified instruction set, while the

others are handled by software when needed. This results in a much faster machine. The duel between CISC and RISC is shaping up as one of the most interesting technological confrontations in the industry today.

This brief overview is far from comprehensive. There are many other technological and commercial dimensions to this industry that have not been addressed: disk drives, printers, networks, modems, etc. These peripherals and their suppliers comprise a fascinating and vital part of this industry. However, the additional detail and complexity that would be introduced by summarizing these factors are not vital to this research. Hopefully the previous discussion has exposed prime factors in the industry and will be sufficient for the purpose of erecting a general backdrop to the study.

REFERENCES

REFERENCES

A

Abernathy, W.J., Clark, K.B. and Kantrow, A.M. (1983) *Industrial Renaissance.* New York: Basic Books.

Aguilar, F. J. (1967) *Scanning the Business Environment.* New York: MacMillan.

Amigoni F. (1978) Planning management control systems. *Journal of Business Finance and Accounting*, 5(3), 279-291.

Anderson, C.R. and Paine, F.T. (1978) PIMS: a reexamination. *Academy of Management Review*, 3(3), 602-612.

Ansoff, H.I. (1965) *Corporate Strategy: An Analytic Approach to Business Policy for Growth Expansion.* New York: McGraw-Hill.

Ansoff, H.I., Avner, J., Brandenburg, G., Portner, F.E. and Radosevich, R. (1970) Does planning pay? The effect of planning on success of acquisitions in American firms. *Long Range Planning, 3(2), 2-8.*

Anthony, R.N. (1965) *Planning and Control Systems: A Framework for Analysis.* Boston: Division of Research, Harvard Business School.

Argyris, C. (1977) Organizational learning and management information systems. *Accounting, Organizations and Society*, 2(2), 113-123.

Argyris, C. and Schon, D.A. (1978) *Organizational Learning.* Reading, MA: Addison-Wesley.

Armstrong, J.S. (1991) Strategic planning improves manufacturing performance. *Long Range Planning, 24(4), 127-129.*

B

Bahrami, H. and Evans, S. (1989) Strategy making in high-technology firms. *California Management Review*, 31(2), 107-128.

Baiman, S. (1982) Agency research in managerial accounting a survey. *Journal of Accounting Literature, 1, 154-173.*

Baiman, S. and Evans, J.E. III (1983) Pre-decision information and participative management control systems. *Journal of Accounting Research*, 21(2), 371-395.

Bain, J.S. (1956) *Barriers to New Competition.* Cambridge: Harvard University Press.

Birnberg, J.G. and Snodgrass, C. (1988) Culture and control: a field study. *Accounting, Organizations & Society, 13(5)*, 447-464.

Birnberg, J.G., Turopolec, L. and Young, S.M. (1983) The organizational context of accounting. *Accounting, Organizations and Society*, 8(2/3), 111-129.

Boretsky, M. (1977) Concerns about the present American position in international trade. *Technology and International Trade*, Washington, D.C.: National Academy of Sciences.

Boretsky, M. (1982) The threat to U.S. high technology industries economic and national security implications. Draft, International Trade Administration, U.S. Department of Commerce.

Bourgeois, L.J. III (1980) Strategy and environment: a conceptual integration. *Academy of Management Preview*, 5(1), 25-39.

Burchell, S. Clubb, C. Hopwood, A. Hughes, J. and Nahapiet, J. (1980) The roles of accounting in organizations and society. *Accounting, Organizations and Society*, 5(1), 5-27.

Burnett, C.D., Veskey, D.P. and Richardson, D. (1984) New roles for corporate planners in the 1980s. *Journal of Business Strategy*, 4(4), 64-68.

Burns, T. and Stalker, G. (1961) *The Management of Innovation.* London, Tavistock.

Burt, D. (1978) Planning and performance in Australian retailing. *Long Range Planning*, 11,62-68.

C

Camillus, J.C. (1972) Formal planning systems: their place in the framework of planning and control. *Economic and Planning Weekly*, February 26, M2-M6.

Camillus, J.C. (1984) Technology-driven and market-driven life cycles: implications for multinational corporate strategy. *Columbia Journal of World Business*, 19(2), 56-60.

Camillus, J.C. (1986) *Strategic Planning and Management Control.* Lexington, MA: Lexington Books.

Camillus, J.C. (1988) Strategic vision and organizational performance: capturing the dimensions of strategic choice. Working Paper WP-684, University of Pittsburgh.

Camillus, J.C. and Datta, D.K. (1991) Managing strategic issues in a turbulent environment. *Long Range Planning*, 24(2), 67-74.

Camillus, J.C. and Grant, J.H. (1980) Operational planning: the integration of programming and budgeting. *Academy of Management Review*, 5,369-379

Carroll, D.T. (1983) A disappointing search for excellence. *Harvard Business Review.* 61(6).

Cassidy, R. and Dougherty, E. (1989) John Young of Hewlett-Packard named executive of the year. *Research & Development*, 31(7), 60-66.

Chakravarthy, B.S. (1986) Measuring strategy performance. *Strategic Management Journal*, 7, 437-458.

Chakravarthy, B.S. (1987) On tailoring a strategic planning system to its context: some empirical evidence. *Strategic Management Journal*, 8, 517-534.

Chase, R.B. and Erikson, W.J. (1988) The service factory. *Academy of Management Executive*, 2(3), 191-196.

Cool, K.O. (1985) Strategic group formation and strategic group shifts: a longitudinal analysis of the U.S. pharmaceutical industry, 1963-1982. Unpublished doctoral dissertation, Purdue University.

Cool, K.O. and Schendel, D. (1988) Performance differences among strategic group members, *Strategic Management Journal*, 9, 207-223.

Cronbach, L. (1951) Coefficient alpha and the internal structure of tests. *Psychometrika*, 16, 197-334.

Cusack, S. (1992) DEC reorganization paves the way for Alpha. *Computerworld*, 26(6), 1, 14.

D

Daft, R.L. (1983) Learning the craft of organizational research, *Academy of Management Review*, 8(4), 539-546.

Day, D.L. DeSarbo, W.S. and Oliva, T.A. (1987) Strategy maps: a spatial representation of intra-industry competitive strategy. *Management Science*, 33(12), 1534-1551.

Dechert, C.R. (1966) *The Social Impact of Cybernetics.* South Bend, IN: University of Notre Dame Press.

DeGeus, A.P. (1988) Planning as learning. *Harvard business Review*, 66(2), 70-74.

Dess, G.G. and Beard, D.W. (1984) Dimensions of organizational task environments. *Administrative Science Quarterly*, 29(1), 52-73.

Dess, G.G. and Davis P.S. (1984) Porter's generic strategies as determinants of strategic group membership and organizational performance. *Academy of Management Journal*, 27(3), 467-488.

Dewar, R.D. and Dutton, J.E. (1986) The adoption of radical and incremental innovations; an empirical analysis. *Management Science*, 32(11), 1422-1433.

Dill, W.R. (1958) Environment as an influence on managerial autonomy. *Administrative Science Quarterly*, 2, 409-443.

Duncan, R.G. (1972) Characteristics of organizational environments and perceived environmental uncertainty. *Administrative Science Quarterly*, 17(2),313-327.

E

Eisenhardt, K.M. and Bourgeois, L.J. III (1988) Politics of strategic decision making in high-velocity environments: toward a midrange theory. *Academy of Management Journal*, 31(4), 737-770.

Emery, F.E. and Trist, E. (1965) The causal texture of organizational environments. *Human Relations*, 18, 21-31.

Eschenbach, T.G. and Geistauts, G.A. (1987) Strategically focused engineering design and management. *IEEE Transactions on Engineering Management*, EM-34(2), 62-70.

Ettlie, J.E. III (1988) *Taking Charge of Manufacturing.* San Francisco: Jossey-Bass.

Evans, J.H., III, Lewis, B.L. and Patton, J.M. (1985) An economic modeling approach to contingency theory and management control. University of Pittsburgh, working paper.

F

Finan, W.F. and Sandberg, K.M. (1986) The U.S. trade position in high technology: 1980-1986. Report prepared for the Joint Economic Committee of the United States Congress.

Fiol, M.C. and Lyles, M.A. (1985) Organizational learning. *Academy of Management Review*, 10(4), 803-813.

Foster, R.N. (1986) *Innovation: The Attacker's Advantage.* New York: Summit Books.

Fredrickson, J.W. (1983) Strategic process research: questions and recommendations. *Academy of Management Review*, 8(4), 565-575.

Fredrickson, J.W. and Mitchell, T.R. (1984) Strategic decisioning processes: comprehensiveness and performance in an industry with an unstable environment. *Academy of Management Journal*, 27(2), 399-423.

Frohman, A.L. (1985) Putting technology into strategy. *Journal of Business Review*, *5*(4), 54-65.

Frohman, A.L. (1982) Technology as a competitive weapon. *Harvard Business Review*, 60(1), 97-104.

Fusfield, A.R. and Spital F.C. (1980) Technology forecasting and planning in the corporate environment: survey and comment. *Management of Research and Innovation*, Dean, B.V. and Goldhar, J.L. (ed.), New York: North-Holland.

G

Gorry, G.A. and Scott Morton, M.S. (1971) A framework for management information systems. *Sloan Management Review*, 13(1).

Grant, J.H. Ed., (1988) *Strategic Management Frontiers.* Greenwich, Conn.: JAI Press.

Grant, J.H. and King, W.R. (1982) *The Logic of Strategic Planning.* Boston: Little, Brown and Company.

Green, S.G. and Welsh, M.A. (1988) Cybernetics and dependence: reframing the control concept. *Academy of Management Review*, 13(2), 287-301.

Greene, T. (1989) The John Young way keeps the legacy of HP intact. *Electronic Business,* 15(21), 38-44.

Greer, C.R. and Ireland, T.C. (1992) Organizational and financial correlates of a "contrarian" human resource investment strategy. *Academy of Management Journal,* 35(5), 956-984.

Griliches, Z. (1984) *R&D, Patents, and Productivity.* Chicago: University of Chicago Press.

Grinyer, P.H. and Norburn, D. (1974) Strategic planning in 21 U.K. companies. *Long Range Planning,* 7(4), 80-88.

H

Hall, R. (1992) The strategic analysis of intangible resources. *Strategic Management Journal,* 13, 135-144.

Hambrick, D.C. and MacMillan, I.C. (1985) Efficiency of product R&D in business units: the role of strategic context. *Academy of Management Journal,* 28(3), 527-547.

Hambrick, D.C., MacMillan, I.C. and Barbosa, R.R (1983) Business unit strategy and changes in the product R&D budget. *Management Science,* 29(7), 757-769.

Hamel, G. and Prahalad, C.K. (1989) *Strategic Intent.* Harvard Business Review, 67(3), 63-76.

Harrigan, K.R. (1985) An application of clustering for strategic group analysis. *Strategic Management Journal,* 6, 55-73.

Harrigan, K.R. (1983) Research methodologies for contingency approaches to business strategy. *Academy of Management Review,* 8(3), 398-405.

Hartigan, J. (1975) *Clustering Algorithms.* New York: John Wiley.

Hatten, K.J. (1974) Strategic models of the brewing industry. Unpublished doctoral dissertation, Purdue University.

Hatten, K.J. and Hatten, M.L. (1987) Strategic groups, asymmetrical mobility barriers and contestability. *Strategic Management Journal,* 8, 329-342.

Hatten, K.J. and Schendel, D.E. (1975-76) Strategy's role in policy research. *Journal of Economics and Business,* 28,195-202.

Hatter, V.L. (1985) U.S. high technology trade and competitiveness. U.S. Department of Commerce.

Hax, A.C. and Majluf, N.S. (1990) *Strategic Management: An Integrative Perspective.* Englewood Cliffs, NJ: Prentice-Hall.

Hayes, R.H. and Abernathy, W.J. (1980) Managing our way to economic decline. *Harvard Business Review*, 58(4), 67-77.

Hayes, R.H. and Jaikumar, R. (1988) Manufacturing crises: new technologies, obsolete organizations. *Harvard Business Review, 66(6), 77-85.*

Hedberg, B. (1981) How organizations learn and unlearn. In Nystrom, P.C. and Starbuck, W.H. (Eds.) *Handbook of Organizational Design.* London: Oxford University Press.

Hedberg, B. and Johnsson, S. (1976) Designing semi-confusing information systems for organizations in changing environments. *Accounting, Organizations and Society, 3*(1), 47-64.

Henderson, B.D. (1973) The experience curve reviewed, IV. The growth-share matrix of the product portfolio. The Boston Consulting Group, Perspectives, No. 135, Boston.

Henry, H.W. (1967) *Long Range Planning Practices in 45 Industrial Companies.* Englewood cliffs, NJ: Prentice-Hall.

Herold, D.M. (1972) Long-range planning and organizational performance: a cross-validation study. *Academy of Management Journal*, 15(1), 91-104.

Hill, G.C. (1989) HP joins forces with Samsung in workstations. *Wall Street Journal*, August 8.

Hof, R.D. (1992) Suddenly, Hewlett-Packard is doing everything right. *Business Week*, March, 23, 88-89.

Hofer, C.W. and Schendel, D. (1978) *Strategy Formulation: Analytical Concepts.* New York: West.

Hofstede G. (1978) The poverty of management control philosophy, *Academy of Management Review*, 3, 450-461.

Horwitch, M. and Thietart, R.A. (1987) The effect of business interdependencies on product R&D-intensive business performance. *Management Science*, 33(2), 178-197.

Hoskisson, R.E. and Hitt, M.A. (1988) Strategic control and relative R&D investment in large multiproduct firms. *Strategic Management Journal*, 9, 605-621.

Huber, G.P. (1991) Organizational learning: the contributing processes and the literatures. *Organization Science*, 2(1), 88-115.

Huck, S.W. and Sandler, W.B. (1979) R*ival Hypotheses: Alternative Interpretations of Data Based Conclusions.* New York: Harper & Row.

I

Isaac, S. and Michael, W.B. (1981) *Handbook in Research and Evaluation.* San Diego: Edits Publishers.

J

Jelinek, M. and Schoonhoven, C.B. (1990) *The Innovation Marathon.* Cambridge, MA: Basil Blackwell.

Jemison, D.B. (1981) The importance of an integrative approach to strategic management research. *Academy of Management Review*, 6(4), 601-608.

Jick, T.D. (1979) Mixing qualitative and quantitative methods: triangulation in action. *Administrative Science Quarterly*, 24, 602-611.

K

Kanter, R.M. (1981) Organizational performance: recent developments in measurement. *Annual Review of Sociology*, 7, 321-349.

Kantrow, A.M. (1980) The strategy-technology connection. *Harvard Business Review*, 58(4), 6-21.

Kaplan, R.S. (1984) Yesterday's accounting undermines production. *Harvard Business Review*, 62(4), 95-101.

Kaplan, R.S. (1990) *Measures for Manufacturing Excellence.* Boston: Harvard Business School Press.

Karger, D.W. and Malik, Z.A. (1975) Long range planning and organizational performance. *Long Range Planning*, 8(6), 60-64.

Kelly, R.K. (1977) The impact of technological innovation on international trade patterns, Staff Economic Report, U.S. Department of Commerce.

Kerlinger, F.N. (1986) *Foundations of Behavioral Research.* (3rd Ed.), New York: Holt-Rhinehart and Winston.

Kilmann, R. (1985) Five steps for closing culture-gaps, Ch. 17 in Kilmann, R.H., Saxton, M.J., Serpa, R. and Associates (eds) *Gaining Control of the Corporate Culture.* San Francisco: Jossey-Bass.

King, R. (1983) Hewlett-Packard: challenging the entrepreneurial culture. Harvard Business School Case No. 9-263-035, Boston: HBS Case Services.

King, W.R. (1983) Evaluating strategic planning systems. *Strategic Management Journal, 4, 263-277.*

Kirkpatrick, D. (1992) Breaking up IBM. *Fortune,* 126(2), 44-58.

Klein, H.E. and R.E. Linneman (1984) Environmental assessment: an international study of corporate practice. *Journal of Business Strategy, 5(1), 66-74.*

Krishna, E.M. and Rao, C.P. (1986) Is U.S. high technology high enough? *Columbia Journal of World Business,* 21(2), 47-54.

Kudla, R.J. (1980) The effects of strategic planning on common stock returns. *Academy of Management Journal, 23(1), 5-20.*

L

Labich, K. (1988) The innovators. *Fortune.* 117(12), 5-64.

Landau, M. and Stout, R., Jr. (1979) To manage is not to control: or the folly of type II errors. *Public Administration Review,* 39(2), 148-156.

Lawrence, P. and Lorsch, J. (1967) *Organization and Environment.* Boston: Division of Research, Harvard Business School.

Learned, E. Christiansen, C.R., Andrews, K., and Guth, W. (1965) *Business Policy: Text and Cases.* Homewood, Illinois: Richard D. Irwin.

Leontiades, M. and Tezel, A. (1980) Planning perceptions and planning results. *Strategic Management Journal,* 1,65-76.

Lessner, J. (1989) Performance measurement in a just-in-time environment: can traditional performance measurements still be used? *Cost Management*, Fall.

Lewis, P. and Thomas, H. (1990) The linkage between strategy, strategic groups, and performance in the U.K. retail grocery industry. *Strategic Management Journal*, 11, 385-397.

Lorange, P., Scott Morton, M.F. and Ghoshal, S. (1986) *Strategic Control.* New York: West Publishing.

Lorange, P. and Vancil, R.F. (1977) *Strategic Planning Systems.* Englewood Cliffs, NJ: Prentice Hall.

M

Maidique, M.A. (1980) Entrepreneurs, champions, and technological innovation. *Sloan Management Review*, 21(2), 59-76.

Maidique, M.A. and Hayes, R.H. (1984) The art of high-technology management. *Sloan Management Review*, 21(2), 17-31.

McGee, J. and Thomas, H. (1986) Strategic groups: theory, research, and taxonomy. *Strategic Management Journal*, 7,141-160.

McGinnis, M.A. and Acklesberg, M.R. (1983) Effective innovation management: missing link in strategic planning? *Journal of Business Strategy*, 4(1), 59-66.

Mendell, S. and Ennis, D.M. (1985) Looking at innovation strategies. *Research Management*, 28(3), 33-40.

Meredith, J.R. (1986) Strategic planning for factory automation by the championing process. *IEEE Transactions on Engineering Management*, EM-33(4), 229-232.

Meyer, A. (1982) Adapting to environmental jolts. *Administrative Science Quarterly*, 27, 515-537.

Miles, M.B. and Huberman, A.M. (1987) *Qualitative Data Analysis.* Beverly Hills: Sage Publications.

Miller, D. and Friesen, P.H. (1980) Momentum and revolution in organizational adaptation. *Academy of Management Journal*, 23(4), 591-614.

Miller, D.C. (1983) *Handbook of Research Design and Social Measurement; A Text and Reference Book for the Social and Behavioral Sciences.* New York: Longman.

Mintzberg, H. (1990) The design school: reconsidering the basic premises of strategic management. *Strategic Management Journal,* 11, 171-195.

Mintzberg, H. and Waters, J.A. (1985) Of strategies deliberate and emergent. *Strategic Management Journal,* 6, 257-272.

Mitchell, R. (1989) Masters of innovation. *Business Week.* April 10, 58-62.

Mitchell, T.R. (1985) An evaluation of the validity of correlational research conducted in organizations. *Academy of management Review,* 10(2), 192-205.

N

Naisbitt, J. (1982) *Megatrends.* New York: Warner books.

O

Otley, W.G. (1979) A contingency theory of management accounting: achievement and prognosis. *Accounting, Organizations and Society,* 5(4), 413-428.

Ouchi, W.G. (1979) A conceptual framework for the design of organizational control mechanisms. *Management Science,* 25(9), 833-848.

P

Patz, A.L. (1981) *Strategic Decision Analysis.* Boston: Little Brown.

PC Week (1991) June 17, 157.

Perrow, C. (1967) A framework for the comparative analysis of organizations. *American Sociological Review,* 32, 194-208.

Peters, T.A. and Austin, N. (1986) *A Passion for Excellence.* New York: Warner Books.

Peters, T.A. and Waterman, R.H. Jr., (1982) *In Search of Excellence.* New York: Harper & Row.

Petrov, B. (1982) The advent of the technology portfolio. *Journal of Business Strategy,* 3(2), 70-75.

Porter, M.E. (1980) *Competitive Strategy: Techniques for Analyzing Industries and Competitors.* New York: Free Press.

Porter, M.E. (1985) *Competitive Advantage: Creating and Sustaining Superior Performance.* New York: Free Press.

Porter, M.E. (1981) The contributions of industrial organization to strategic management. *Academy of Management Review,* 6(4), 609-620.

Q

Quinn, J.B. (1985) Managing innovation: controlled chaos. *Harvard Business Review,* 63(3), 73-84.

Quinn, J.B. (1980) *Strategies for Change: Logical Incrementalism.* Homewood, IL: Dow Jones-Irvin.

R

Ramanujam, V. and Venkatraman, N. (1988) Excellence, planning, and performance. *Interfaces,* 18(3), 23-31.

Ramanujam, V., Venkatraman, N. and Camillus, J.C. (1986) Multi-objective assessment of effectiveness of strategic planning: a discriminant analysis approach. *Academy of Management Journal,* 29(2), 347-372.

Reimann, B.C. (1987) *Managing for Value: a Guide to Value-Based Strategic Management.* Oxford, Ohio: Planning Forum.

Robinson, R.B. Jr. (1982) The importance of "outsiders" in small firm strategic planning. *Academy of Management Journal,* 25, 80-93.

Robinson, R.B. Jr. and Pearce, J.A., II (1983) The impact of formalized strategic planning on financial performance in small organizations. *Strategic Management Journal,* 25, 80-93.

Robinson, R.B. Jr. and Pearce, J.A., II (1988) Planned patterns of strategic behavior and their relationship to business-unit performance. *Strategic Management Journal,* 9, 43-60.

Rosch, W.L. (1992) *The Winn L. Rosch Hardware Bible.* New York: Brady Publishing.

Rue L.W. and Fulmer, R. (1973) Is long range planning profitable? *Proceedings of the Academy of Management.*

Ruekert, R.W. and Walker, O.C. (1987) Interactions between marketing and R&D departments in implementing different business strategies. *Strategic Management Journal*, 8(2), 233-248.

Ryans, A.B. and Wittink, D.R. (1985) Security returns as a basis for estimating the competitive structure of an industry. In Thomas, H. and Gardner, D. M. (Eds.) *Strategic Marketing and Management*, New York: John wiley.

S

Sadhu, K.K. and Prescott, J.E. (1986) Comparison of intra-industry membership of strategic groups along five alternative perspectives. *Eastern Academy of Management Proceedings.*

Sands, D.E. (1987) Strategic control through a multiple objectives model. Unpublished doctoral dissertation: University of Pittsburgh.

Schendel, D.E. and Hofer, C.W. (1979) *Strategic Management.* Boston: Little, Brown.

Schoeffler, S. Buzzel, R.D. and Heany, D.F. (1974) Impact of strategic planning on profit performance. *Harvard Business Review*, 52(2), 136-145.

Schoonhoven, C.B. (1984) High technology firms: when strategy really pays off. *Columbia Journal of World Business,* 19(4), 5-16.

Schreyogg, G. and Steinmann, H. (1987) Strategic control: a new perspective. *Academy of Management Review,* 12(1), 91-103.

Schroeder, D.M. and Hopley, R. (1988) Product development strategies for high-tech industries. *Journal of Business Strategy,* 9(3), 38-43.

Senge, P.M. (1990) The leader's new work: building learning organizations. *Sloan Management Review,* 32(1), 7-23.

Sethi, N.K., Mousesian, B. and Hickey, K.D. (1985) Can technology be managed strategically? *Long Range Planning*, 18(4), 89-98.

Sherman, P.M. (1982) *Strategic Planning for Technology Industries.* Reading, MA: Addison-Wesley.

Sherman, S.P. (1984) Eight big masters of innovation. *Fortune,* 110(8), 66-77.

Shrivastava, P. and Grant, J.H. (1985) Empirically derived models of strategic decision-making processes. *Strategic Management Journal,* 6(2),92-113.

Siropolis, N.C. (1986) *Small Business Management: a Guide to Entrepreneurship.* Boston: Houghton Mifflin.

Skinner, W. (1984) Operations technology: blind spot in strategic management. *Interfaces,* 14, 116-125.

Snodgrass, C.R. and Grant, J.H. (1986) Cultural influences on strategic planning and control systems. In Lamb, R.B. and Shrivastiva, P. (Eds.) *Advances in Strategic Management.* Greenwich, CT: JAI Press, 4, 205-228.

Snow, C.C. and Hambrick, D.C. (1980) Measuring organizational strategies: some theoretical and methodological problems. *Academy of Management Review,* 5(4), 527-538.

Snyder, N.H. and Glueck, W.F. (1982) Can environmental volatility be measured objectively? *Academic of Management Journal,* 25(1), 185-192.

Sommers, W.P., Nemec, J. and Harris, J.M. (1987) Repositioning with technology: making it work. *Journal of Business Strategy,* 7(3), 16-27.

Souder, W.E. (1983) Organizing for modern technology and innovation: a review and synthesis. *Technovation,* 2, 27-44.

Souder, W.E. (1987) *Managing New Product Innovation.* Lexington, MA: Lexington Books.

Souder, W.E. and Shrivastava, P. (1984) Towards a scale for measuring technology in new product innovations. *Research Policy,* 14, 151-160.

Steiner, G.A. (1969) *Top Management Planning.* Toronto: MacMillan.

Summer, C.E., Bettis, R.A., Duhaime, I.H. , Grant, J.H., Hambrick, D.C., Snow, C.C. and Zeithaml, C.P. (1990) Doctoral education in the field of business policy and strategy. *Journal of Management,* 16(2), 361-398.

T

Tassey, G. (1983) Competitive strategies and performance in technology-based industries. *Journal of Economics and Business,* 35(1), 21-40.

Tichey, N. and Charan, R. (1989) Speed, simplicity, self-confidence: an interview with Jack Welch. *Harvard business Review,* 67(5), 112-120.

Thompson, J.D. (1967) *Organizations in Action.* New York: McGraw-Hill.

Thompson, A.A., Jr. and Strickland, A.J. III (1987) *Strategic Management: Concepts and Cases.* Plano, TX: Business Publications.

Thune, S.S. and House, R.J. (1970) Where long-range planning pays off. *Business Horizons,* 13, 81-87.

Tosi, H. Aldag, R. and Story, R. (1973) On the measurement of the environment; an assessment of the Lawrence and Lorsch environmental uncertainty subscale. *Administrative Science Quarterly,* 18, 27-36.

U

United States Congress, House Committee on Science, Space, and Technology, Subcommittee on Technology and Competitiveness (1992) *Critical technologies: hearing before the Subcommittee on Technology and Competitiveness of the Committee on Science, Space, and Technology, U.S. House of Representatives, One Hundred Second Congress, second session,* February, 21, 1991, Washington: U.S. Government Printing Office.

United States Congress, Joint Economic Committee (1989) *High technology consortia: the federal role: hearing before the Joint Economic Committee, Congress of the United States, One Hundred First Congress, first session,* June 8, 1989, Washington: U.S. Government Printing Office.

United States Congress, Senate Committee on Commerce, Science, and Transportation (1992) *Oversight of the Exon-Florio Amendment; hearing before the Committee on Commerce, Science, and Transportation, United States Senate, One Hundred Second Congress, first session,* November 19, 1991, Washington: U.S. Government Printing Office.

U.S. Department of Commerce (1983) *An Assessment of U.S. Competitiveness in High Technology Industries.*

U.S. Department of Commerce (1992) *U.S. Foreign Trade Highlights*, 1991.

V

Veliyath, R. (1992) Strategic planning: balancing short-run performance and longer term prospects. *Long Range Planning*, 25(3), 86-97.

Venkatraman, N. and Camillus, J.C. (1984) Exploring the concept of 'fit' in strategic management. *Academy of Management Review*, 9(3), 513-525.

Venkatraman, N. and Grant, J.H. (1986) Construct measurement in organizational strategy research. *Academy of Management Review*, 11(1), 71-97.

Venkatraman, N. and Prescott, J.E. (1990) Environment-strategy coalignment: an empirical test of its performance implications. *Strategic Management Journal*, 11(1), 1-23.

Venkatraman, N. and Ramanujam, V. (1986) Measurement of business performance in strategy research: a comparison of approaches. *Academy of Management Review*, 11(4), 801-814.

Venkatraman, N. and Ramanujam, V. (1987) Planning system success: a conceptualization and an operational model. *Management Science*, 33(6), 687-705.

Von Hippel, E. (1986) Lead users: a source of novel product concepts. *Management Science*, 32(7), 791-805.

W

Waterhouse, J.H. and Tiessen, P. (1978) A contingency framework for management accounting systems research. *Accounting, Organizations and Society*, 3(1), 65-76.

Weigner, K.K. (1990) Good-bye to the HP way? *Forbes*, 146(12), 36-37.

White, G.R. and Graham, M.B.W. (1978) How to spot a technological winner. *Harvard Business Review*, 56(2) 146-152.

Wilsher, P. (1992) Reprogramming IBM. *Management Today*, May, 48-52.

Wood, D.R. and LaForge, R.L. (1979) The impact of comprehensive planning on financial performance. *Academy of Management Journal*, 22(3), 516-526.

Woodward, J. (1965) *Industrial Organization: Theory and Practice*. London: Oxford University Press.

Dissertation Literary Statistics

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Instructional Glossary of Strategy and Technology Terms

Following are some of the terms used in fields of strategy and technology, especially at the practitioner level.
Order of presentation is instructional rather than alphabetic.
Terms are simply defined for background understanding, that the dissertation be more easily entreated.
For deeper understanding, refer to textbooks of the field, including those in the bibliography.

Vision	Statement with inspirational merit revealing a desired future. Left-brain faculties are emphasized. High ideals, worthiest principles, and outcomes that stretch the imagination or seem to transcend what is practically attainable often are expressed.
Mission	Statement of purpose clarifying the *raison det* of the organization and objectively setting dimensions of scope and means. Primarily a right-brain creation, fully rational, practical, and measurable.
Objectives	Measurable targets to be realized within a fairly specific timeframe, proceeding from the charter of the enterprise mission statement.
Management By Objectives	One of the most comprehensive generalizations of the management function, touching each of its primacies (planning, organizing, staffing, directing, and controlling). Systemizes goal-directed activity for effectiveness and accountability.
Strengths	Capabilities of business organizations that are significant or above the competition. Results from internal assessment of the organization.
Distinct Competencies	What a business organization does very well. DCs significantly impact the firm's success. Salient strengths.
Weaknesses	Things that make an organization vulnerable in conducting business, and need shored up.
Opportunities	What a business sees as occasions for new growth. Results from scanning the environment for needs unmet.
Critical Success Factors	Those few organizational capabilities that most determine success based upon demands the industry places upon all contenders.
Threats	Factors in the environment that potentially erode the firm's position
SWOT Analysis	Collective assessment of Strengths, Weaknesses, Opportunities, and Threats, intending to maximize Strengths and Opportunities, and minimize Weaknesses and Threats.
Stakeholder Analysis	Assessment of mutual interest and influence of all environmental entities. Presumes that the firm should successfully satisfy conditions of mutuality to maintain its viability in society. Stakeholders include labor, management, stockholders, consumer groups, government, activist organizations, and professional societies.
Industry	Aggregate of firms engaging in essentially the same line of business.
Industrial Organization	Entity of analysis in the study of industrial activity. Extant theory envisions the firm succeeding as it ideally aligns itself to the specific industry context.
Formal Organization	Legal relationships formalized in structuring a business organization. Often expressed in the form of an organization chart and policy manual.
Informal Organization	Relationships spontaneously arising within an organization that aid or detract from functionality. Corporate culture ascribes power within IO.
M-Form	Multidivisional organization consisting of diversified business units.
U-Form	Centralized organization consisting of business functions (marketing, production, personnel, R&D, finance).
Organic Structures	Relationships in an organization that are flexible and adaptive by processes that emerge naturally and change fluidly.

Instructional Glossary of Relevant Strategy and Technology Terms

Strategic Group	Subgroup of firms in an industry that tend to follow the same strategy.
Mobility Barrier	Strategies that tend to isolate a strategic group from entry or limit exit.
Market Share	A firm's portion of total sales in an industry. Key determinant of size, influence, and success.
Environment	Grand context of doing business. Dimensions of the environment include competition, technology, legal, social, and political.
Niche	Portion of an industrial competitive environment that accommodates but few firms, and tends to limit entry by others when filled.
Environmental Analysis	Increasingly sophisticated process engaged by firms for understanding the many contextual factors that influence their success. Composed of the competitive environment (industry); numerous stakeholders (full array of influencers or inluencees), such as government, trade associations, consumer groups; and binding intangibles (rules, laws, principles, culture, religion).
Strategy	How a firm achieves it objectives and fulfills its mission. It is the cognitive product of firm management intending to produce enduring success.
Strategic Choice	Process of selecting a strategy from the array of possible options.
Strategic Decisionmaking	Intellectual process behind Strategic Choice. Rational-Comprehensive (Synoptic) , Intuitive, Political, and Cultural frameworks for strategic decisionmaking are recognized.
Portfolio Analysis	Abstraction of strategic decisionmaking to improve comprehensibility and tractability. Reduces an n-dimensional problem to two or three dimensions thought to embrace most of what the decisionmaker needs to know. Most popular has been the market-share matrix (Boston Consulting Group). PA has been proposed as an abstracting framework for high tech decisionmaking.
Agency Theory	Rationalizing business decisions and organizational relationships in terms of a principal-agent model.
Performance	Absolute or relative measurement of an organization's success. Usually financial scaling is used, but nonfinancial measures also factor into the performance array as understanding and information management enables deeper reach into organizational process.
Competitive Advantage	Achieving a status of superior performance relative to others in the competitive domain.
Strategic Planning	Planning that encompasses the largest scope and longest timeframe on behalf of organizational success, for which it is most responsible. Also referred to as policy, business policy, strategic management, long-range planning, corporate planning, synoptic planning, and rational-comprehensive planning.
Operational Planning	Organizational planning that is of smaller scope and shorter time horizon than strategic planning. Usually one year of operation is covered in terms more programmatic and less conceptual than the firm's strategic plan.
Planning Horizon	Length of time the plan attempts to address for composing successful conduct of business.
Implementation	Collaborative organizational activity that puts a plan into action. Since it involves commitment or resources (capital, equipment, manpower), it is the most expensive part of the strategic management process, least tolerant of error.

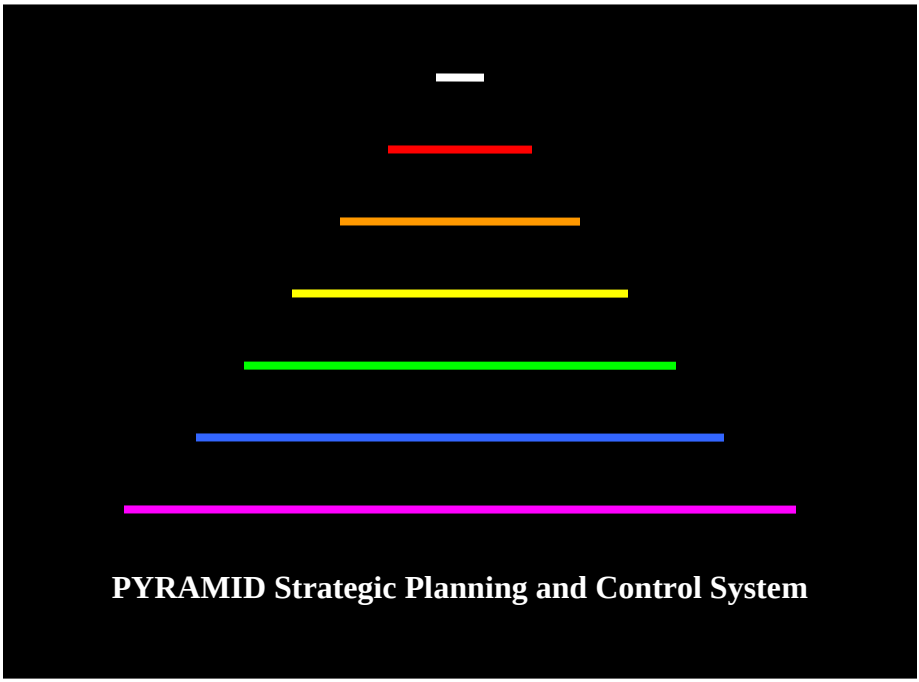
Instructional Glossary of Relevant Strategy and Technology Terms

Control	Business function that corrects performance shortfalls and damaging errors. Strategic control is responsible for keeping the firm's strategy perfectly aligned with the environment and the organization across time.
Corporate Culture	The value system evolved over the life of an organization that portrays its character. Many management experts believe the evolutionary nature of corporate culture can, with today's deeper understanding, be managed for improved effect.
Technology Culture	Corporate culture specifically developing and managed towards technological excellence. Exists in high technology firms with distinction according to a diversity of types (Technoplanners, Technovisionaries, Technopreneurs, etc.)
Product	Market offering of a business organization. May be a product, service, or idea.
Life Cycle	Length of time a strategy or product is in service and delivering expected returns. Both product life cycles and strategy life cycles have been shortening, especially in high tech enterprise.
Business Risk	Degree of uncertainty that accompanies decision to commercialize a successful product. Includes Financial Risk, Market Risk, Competitive Risk.
Technical Risk	Degree of uncertainty that accompanies pursuit of a technological advance. Often expressed as probability of success evoked by subjective judgments of experts in the relevant technical fields.
Distinct Technical Competence	Among the technological strengths of an organization, those technical competencies that are leading edge in their specialty, or are leading edge within the industry.
Strategic Technical Areas	Technologies regarded to be instrumental to progress of the industry, and in which the firm must do well if it is to compete successfully.
Economies of Research	Expanding the *research concept* for technological advance to include joint ventures, consortia, expert consultancy, academic research, customer boards, consumer interest groups, technical market research, government contracts, media research, etc..
Technology Portfolio	Simplifying abstractions, usually 2 X 2 matrices, arraying technical advance difficulty and market reward to technology performance, the basic Technology Question. Petrov (1982) prescribes a technology attractiveness/relative technological position matrix. Sethi et al. (1985) array technology importance vs. relative technology position.
Benefit/Cost Analysis	Ratio analysis that guides decisionmaking by maximizing the quotient of dollar benefits to cost among competing options. For technical advances, B/C compares the anticipated market reward for a product development to the cost of R&D behind the product.
Risk Analysis	Sophisticated decisionmaking process often used to evaluate technological advancement opportunities. Utilizes subjective judgments of experts in composing a probability continuum for outcomes that quantify risk and reward.
Technological Advance	Step beyond the Technology Frontier of discovery. Usually measured in terms of increased capability, such as lumens per watt in the field of illumination. Historical array of Tas permits judicious pondering about magnitude of the step, cost of the increment of advance, and market reward.

Instructional Glossary of Relevant Strategy and Technology Terms

Technological Substitution	Prime tool of Technology Forecasting for evaluating the rate at which a new technology overtakes an obsolescing technology. Substitution rates vary with amazing predictably. Analyses of substitution phenomena allows business enterprises to transition more smoothly to new technologies or spot new fields of opportunity earlier in their emergence.
Kondratiev Waves	A technology parallel to business cycles, Kondratiev waves record innovation history as epochal , rather than uniformly distributed across time. Associated theory tries to explain periods of latency and periods of extreme innovation output. Emergent Trend Analysis can alert to prolific invention seasons and release entrepreneurial talent into the development process.
Technology Forecasting	Relatively new but underdeveloped field of expertise intending to predict technology futures. Deterministic qualities are rejected by some believing invention to be unpredictable or technical advances unquantifiable along the time continuum.
Radical Innovation	Technology Advancements that are extreme and discontinuous departures from past advances. Fluorescent lamps exemplify a radical innovation in illumination with respect to incandescent technology.
Incremental Innovation	Most innovation proceeds in orderly, small steps of Technological Advance, known as Incremental Innovation. Relative to the above example from illumination engineering, companies improving phosphors, ballasts, starters, switches, and reflectors used with fluorescent lamps engage incremental innovation.
Innovation Analysis	Illuminating investigation of successful innovations within a company or industry to discern factors of origination. Presumes that those better understanding innovation process and idiosyncrasies will do better at making advances.
Emergent Trend Analysis	Pioneered by Naisbitt (Megatrends, 1982), ETA scours media for hints of societal change, especially as they bring new business opportunities. Simplest index of attention is cumulative inches of news print associated with a new development. Can be tailored to technology-rich opportunities.
Technical Components Factoring	An innovation primer in the array of Technology Forecasting tools, Technical Components Factoring decomposes sophisticated processes and products into fundamental components, then reassembles the rudiments with combinatorial variety. Expectation is that some combinations studied will be novel and disclose unanticipated pathways to innovation.

POST SCRIPT



A consequence of this research in strategic planning and control in high technology firms was development of a unique strategic planning and control system by the author. Because of its hierarchical structure, it was accorded the name: PYRAMID. The system was deployed on computer to make advantageous use of electronic (paperless) media, rapid review and updating, and quantitative rationalizing of plan and control elements.

Some management experts have signaled the end of formal, rational, comprehensive planning, claiming it too cumbersome for a fast-paced world, especially in the hyper-pace of high tech. This Executive Software attempts to rescue truly cognitive synoptic planning by implementing a cohesive, comprehensive design for planning and controlling, and arraying it on the lightning-fast platform of modern, networkable computers. PYRAMID erects a track upon which sound strategic planning can occur. It evokes the wisdom of strategy managers, and helps them to orchestrate their vision, mission, objectives, strategies, programs, and projects coherently. Plan elements are systematically prioritized. Implementation progress may be instantly recorded, keeping the plan and control process continually current. Vital ideas and guidance no longer surrender to executive schedule conflicts and delays in paper-plan publication. PYRAMID does for strategy managers and professionals what corporate information

systems have been doing with great success for overseers of marketing, production, finance, or human resources.

Salient attributes of PYRAMID are enumerated below. Executive Software is available. Seminars to learn the PYRAMID Strategic Planning and Control Process may be scheduled. The PYRAMID system will be used by the Priesthood of Science and Technology in composing the high-technology agenda of the Global Environmental Service. It is believed to offer the best benefit/cost ratio of commercially available, systematized strategic planning processes. There are no sure, programmatic ways to plan at the high conceptual level that top management and strategy professionals engage. In this regard, PYRAMID is more a thinking tool, a formalizer, a sharable frame of reference. It can be no better than the quality of incoming creativity and management expertise. Its electronic canvas will, however, allow things planned to assemble rationally and controllably, like pieces of a puzzle coming together via individual minds operating within a geographically-separated, asynchronous group process.

PYRAMID Strategic Planning and Control Process Advantages		
Paperless Planning	**Instant Access**	**Idea-Driven**
Rational Hierarchy	**Instant Updating**	**Fully-Integrated Planning**
Coherent	**Instant Publication**	**Seven Sophistication Levels**
Comprehensive	**Distributed Input Process**	**Speeds Decision Making**
Effortless	**Time-Efficient Process**	**Minimizes Administration**
Eliminates Planning Cycle	**Most Economical**	**Fun to Use – Fun to Plan**
Continuous Planning Model	**Efficient Manpower Use**	**Heightens Interest and Care**

Technology Strategy and Strategic Group Graphics

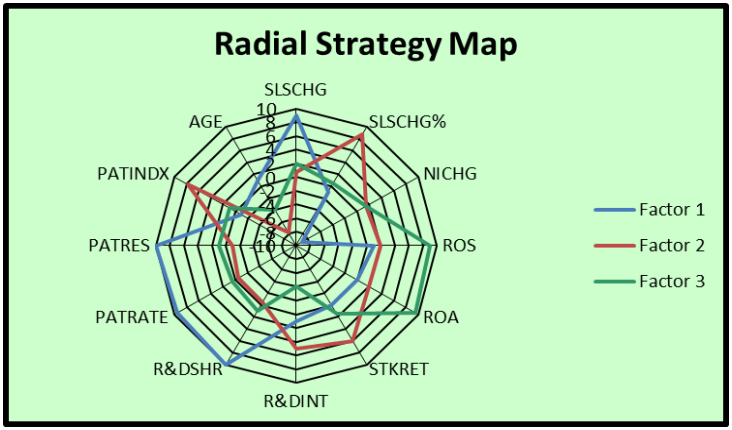
Salient in the subject matter and methodology of this Thesis is the relatively new construct of Strategic Groups, a key research interest of the author. They are intermediate between industry and individual firms composing an industry. As business activity matures, industries can be expected to become more populous and strategies for success more innovative and diversified. Accordingly, Strategic Groups hold the promise of evoking key pathways for service and success, of identifying emerging, permanent niche structures in an evolving industry life.

In the domain of high technology, strategic saliencies orient towards creativity, innovation, research, growth, and capital formation. Strategic Groups in high tech industries are therefore inclined to be richer in Technology Strategy Content as they make a discernible Strategic Imprint. Attempts to read the emerging "fingerprints" of advanced high-tech management can benefit from enlarging and refining the graphical instrumentalities used, thereby hastening recognition.

The original Thesis work in Technology Strategy Space reduction from n-dimensions to three-dimensional space is amenable to further refinement by intelligent use of high tech graphical methodologies. A few of these are demonstrated in the following sections with the hope of further advancing Technology Strategy and Strategic Group research.

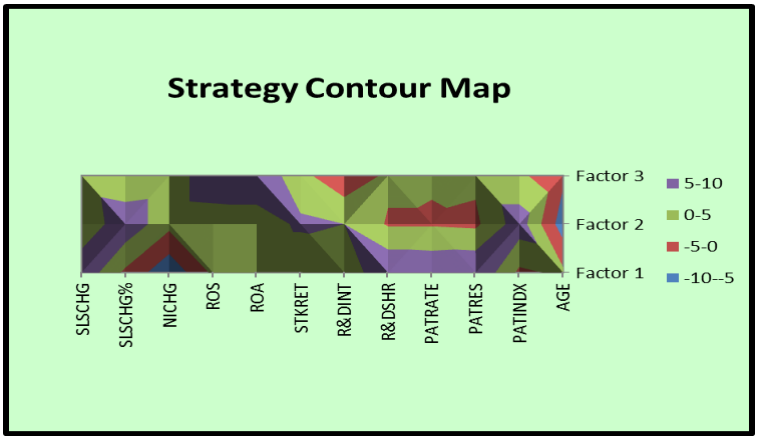
From Planar to Polar Graphical Simplification

The following Radial Graph of Technology Strategy Content in the Computer Industry affords a rather easy reduction of symbolic information from three views to one view without loss of information. It is an efficient and expandable forma for registering the increasingly multidimensional nature of strategy weaving into Technical Strategy as a pleasingly concise, easily interrogated figure:



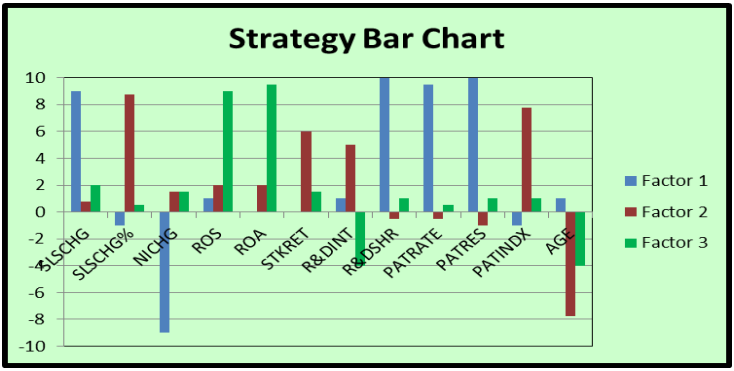
Visualize the Radial Strategy Map as a clock face with Performance Variables arrayed from 12 O'clock to 5 O'clock, and Technology Strategy Content Variables arrayed from 6 O'clock to 11 O'clock. Collectively, these 12 variables *finely* compose Strategy Space (that is, the Strategy-Performance Domain). Sophisticated Factor Analysis reduced 12-Dimensional Strategy Space to a clean and efficient Three-Dimensional Strategy Space. The Radial Strategy Map brings even more valuable (information-preserving) simplification by digesting all three factors to a single two-dimensional graphic (instead of the three separate planar views or condensed but imprecise volumetric construction shown in the body of the Thesis document as Figures 3-6).

From Discrete Points to Flowing Contours



The Strategy Contour Map above presents Strategy Space according to a topographical discipline akin to looking from heaven at hills and valleys of geographic domains like Cities, Counties, States, and Nations. Original strategy variables of importance are arrayed along the horizontal axis: a sequence of 6 Performance Variables followed by 6 Technology Strategy Content Variables. The three dimensions of factor-analytic reduced Strategy Space are arrayed along the vertical axis. Were the Factors post-interpretable, changes along the vertical dimension could be further enlightening. Relational saliences among Technology Strategy Variables are readable by color-coded isoclines, made more explicit by shadowing, to simulate out-of-page, third-dimension relief. Since both negative and positive values in excess of 5 are most significant statistically, coarse-scaled, four-color coding is generally instructive for interpreting Strategy Contour Space.

From Triplicate Vectors to Singleton Bar Magnitudes



The Strategy Bar Chart invokes an "old friend" of business graphing for the present task of interpreting Multidimensional Strategy Space. Instead of projecting saliences by vectors in Planar or Volumetric Strategy Space (as in the original Thesis graphics), or by relief (as in the preceding Contour Strategy Map), Strategy Content Variables rising to importance are displayed by parallel bars of varying length or "strength" in a simple two-dimensional "paper" plane. Information contributed by statistical factoring is not so spatially precise as vectors in 3-D Strategy Space or Volumetric Strategy coordinate systems. Rather, magnitudes of factor communalities are set side-by-side at each point of variable registration along the horizontal axis. This graphic design highlights the simple-structure benefit of Varimax factor rotation. Only one loading for each of the three qualifying factors is likely to be salient for each variable, greatly simplifying understanding of otherwise complicated multidimensional information. Clustering output (performance) variables together and separate from input (strategy content) variables also aids interpretation. Factor Analytic "orthogonalizing" renders a rather clean representation of cause and effect, although dual loadings of some variables in the factor structure can lead to ambiguity (e.g., AGE and R&DINT).

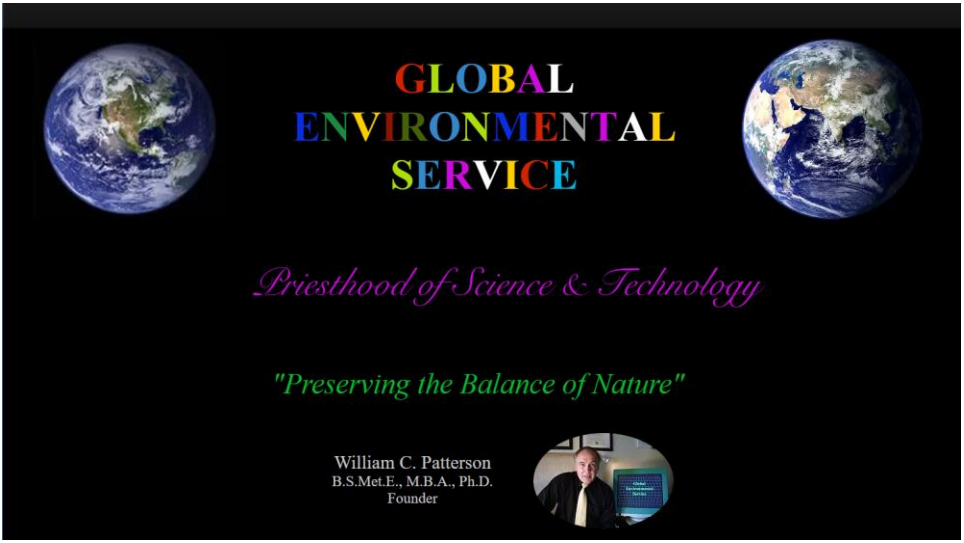
Global Environmental Service	*Priesthood of Science and Technology*
Global Environmental Service and Priesthood.WMA	

GES Conceptualized 2000
GES Registration in Pennsylvania 2008
GES Website Launched 2016

Researching strategic planning and control systems in high technology firms has increased awareness of the great power of knowledge and technology wielded by men and organizations and nations in these times of rapid change. True to the prediction of Jesus Christ, we now can move mountains and do even greater works than He did. Chronicled enterprise and industry characteristics of hyper-pacing; short product lifetime; high organization attrition; structural erosion of industry, corporate, and management rationality; large capital failure magnitudes; swelling manpower dislocation; etc., communicate unequivocally that the modern management process is not yet commensurate to the extraordinary demands of high-tech.

Further limiting the benefit of high tech to mankind is proprietary spirit. Not addressed by this thesis research is the emergence of a rather small club of nations, known as the Triad, who support and benefit most from the high-tech miracle. These nations have a self-renewing appetite for sophisticated products, but tend to constrain the liberating nature of high tech enterprise to themselves. Urgencies and opportunities for deep economic development in lesser-developed and under-developed nations thereby factors as the opportunity cost of technical self-indulgence.

The **Global Environmental Service** (GES) was conceived by the author as a timely internationalization of Christian talent in science and technology. It is responsive to needs expressed in the augmented thesis publication of 2005 to set the administration of high technology cleanly under God, for the benefit of all peoples and nations. GES will strategically situate on neutral ground, answerable to no sovereignty but God, and biased by no single world culture except God's Kingdom culture. Holy men from every nation, qualified to the highest degree in science and technology, and called by God to minister in peace to international needs, without partiality, compose the human agency of Global Environmental Service. This **Priesthood of Science and Technology** will be on call to any nation, literally a prayer away, and capable in the Lord to provide very present help in times of trouble. *Psalm:46.1;60.11*



GES will be facilitated via bridging arrangements with individuals, corporations, cities, states, and nations. Through endowment with the latest in habitat design, work environment, plant & equipment, logistics, transportation, and communication, these modern missionaries in Christ will be able to bring the best of God and man to establishing and maintaining heaven on earth at global scope, as promised in the Holy Scripture, and finally within our grasp.

Pan American Headquarters for GES is to be located near the centroid of the Pan American land mass. The structure envisioned is a Pyramid of such magnitude that it will host thousands of residents within a single building and become the world's first Technology City. The massive pyramidal structure is not only sound engineering for the tropical zone, but it rescues an important symbol of ancient times. Pyramids of Egypt and Mexico were man-made mountains, interwoven with sun worship, impressively decorating architectural history. They decorate spiritual history as tomb stones and places of extreme blood sacrifice, sadly unholy. Global Environmental Service will give the world its largest pyramid yet. This unique and grand architecture finally and eternally will be dedicated as a mountain of holiness, ascending into the heavens in totally-surrendered Christian service near the heart of Almighty God. Pyramid architecture, unique and inspired by God, possessed great but failed potential in Moses' day for His people Israel to become a priesthood to Egypt, welcoming them into Abrahamic Covenant. To Latin America, the pyramid was a temple with promise for transition from bloody-to-bloodless sacrifices to God, consequential to Spanish evangelism of Mexico. The pyramid of Global Environmental Service finally vindicates God's sacred trinity and holy mountain architecture. It is a fully peaceful, sun-powered, Son-powered, heaven-on-earth offering to Him. Pyramid City crowns the Millennial Church Age with peace,

seeding heaven on earth, and eventually embracing all mankind in its selfless ministry of abundant life, as promised by Jesus Christ. While time and place of our Lord's return remain mysteries in God's hands, we know that our High Priest, holy and harmless, would be able to live happily and safely in the special habitat of GES Headquarters, aptly surrounded by willing and able instruments to do His peaceful and righteous and glorious bidding during an unprecedented, one-thousand-year reign.

The thief cometh not, but for to steal, and to kill, and to destroy:
***I am come that they might have life**,*
*and that they might have it **more abundantly**.*
John:10.10

GES Initiatives	
Pennsylvania House	*Venezia Solarized Cargo Sailing Ship*
High Technology Pyramid City	*Home Food Fish Aquarium*
Caribbean Tower Complex	*Neighborhood Food Fish Aquarium*
Green Fitness	*Home-Based Eagle Garden*
Priesthood of Science and Technology	*Green Fire Home Heating*
Marie Society	*Home Energy Garden*
Mary Society	*River Power*
Science Calculator	*River Equity*
Science Library	*Tunnel Bridge*
Daily Bread	*Linear Bridge*
Catalysm Health	*Solar Awnings*
Garden Under Glass	*Apartment Wind Energy Pedestal*
Tropic Light House	*City Aero Architecture*
Black Beauty Flooring	*Angel Wing Family Aircraft*
Rio Alto River of Purified Water	*Gravity Catapult*
Sun Salon Electric Family Vehicle	*Aircraft Parachute*
TriGo Family Vehicle	*Thruster Cold Jet Engine*
Double Eagle Bus	*Multi-Blade Multi-Prop Engine*
Family Cargo Truck	*Roto-Wing*
Bubble Power Chair	*Flexible Auto Body Sheet*
SOLO Solarized Power Chair	*Spanel Lightweight Construction Unit*
Jet Stream Motorcycle	*Equine Family Transportation*
Balance Motorcycle	*Solar Passenger & Auto Train*
Ranger Scooter	*Hot-Air Balloon Transportation*
Admiralty Class Genesis Submarine	*Paperless Toiletry*
Total Solar Home	*Lite-Duct HVAC*
HVAC Window	*Fracohol Fuel*
Fire Safe Home	*Four-Quarter Drawer Bed*

Millennial Home *Solar Ceiling* *Solarian Home* *Garden Tower Urban Apartment* *Triangular Utility Bus* *Utility Sidewalks* *Solar Awnings* *Vertical Solar Awnings* *Solar Vertical Blinds* *Lunar Shuttle*	*Multi-Mattress* *Eaglet Ultra-Light* *Sky Ship Dirigible* *Sun Rise Solar Aircraft* *Aero Mall* *Aero Hospital* *Accident-Free Flight Policy* *High-Tech Traffic Control Light* *Life Way Road Design*

Global Environmental Service

Inspirational Music for Christian Initiatives

Empowering Programs, Projects, and Processes for World Peace

GES Initiative	***Fully Orchestrated Motivational Music***
Priesthood of Science & Technology	*At the Cross*
Green Energy	*Green Fire* *Green Colors*
Environmental Stewardship	*Good Green Earth*
Lunar Power Station	*Fly Me To The Moon*
Genesis Submarine	*World of the Sea*
Solar Train	*Sentimental Journey*
Financial Reform	*Chasing Money*
Addiction Management	*Pleasure Tyrant*
Love of Country	*Sacred American Trilogy*
Christian Education	*War March of the Priests*
Christ in the Media	*Have You Seen Me Lately?*
Courage Amidst Adversity *Climate Disasters, Wars, Terrorism*	*Seventy-Seven Ways* *Got Any Rivers* *Summertime* *Lord Have Mercy on the U.S.A.* *Spirit High* *Let's Talk to God*
Honor Father	*Laughter from the Heart*
Honor Mother	*Silent Night*
Restore Modern Woman *Seek Love, Marriage, Home, Children*	*Pretty Enough* *Queen of the Night* *Shake, Rattle and Roll* *Be My Baby Tonight*

Simplify Modern Life	*Simplification* *Flowing & Growing*
Restore Daughters *Honor Holiness* *Seek Motherhood & Children*	*Sweethearts* *Song of Marie* *Younger Mama*
Affordable Housing & Land	*Welcome Home Children*
Garden Tower Hi-Rise Apartment	*In the Garden*
Remember Holy Days *Christmas* *Thanksgiving* *Reformation* *Labor Day*	 *Jesus* *Thanksgiving* *A Mighty Fortress is Our God* *Material Men*
Honor Wedding Day	*Lord's Prayer*

Author Biographical

Professional Profile *William C. Patterson, Ph.D.*

Career Synopsis

Dr. William C. Patterson is an executive, management consultant, public policy advisor, educator, researcher, scientist and engineer, inventor, entrepreneur, music vocalist and composer, writer, and Christian life advocate. Work on energy systems for the post-petroleum era, and global architecture for the Great Society are major lifetime professional contributions.

Educational

Doctor of Philosophy
1992

Katz Graduate School of Business, University of Pittsburgh
Major: Strategic Planning and Policy
Minor: Management Control
Thesis: *Strategic Planning and Control for High Technology Firms.*
Research Interests: *High-Technology Strategy, Strategic Group Theory, Strategic Decision-Making, Strategic Primacy*

Master of Business Administration
1970
Graduate School of Business
University of Pittsburgh
Minor: Operations Research

Bachelor of Science
1966
Materials Science / Metallurgical Engineering
School of Engineering
University of Pittsburgh
Cum Laude
Thesis: *Quantitative Optical Measurement of Aluminum Finish Using Abridged Goniometer*

University of Pittsburgh Diplomas
Triple Crown of Engineering & Management
329 Credit Hours in 17.5 Years of Higher Education
All Christmas Season Graduations: Knowledge Gift from God

M.S.
48 Credit Hours
3 Years

Ph.D.
56 Credit Hours
9 Years

B.S.
66 Credit Hours Pitt
159 Semester Hours USAFA
225 Total B.S. Credit Hours
5.5 Years

United States Air Force Academy

USAFA was Established in 1954 and Has Been Visited by Hundreds of Thousands Annually
Set on 18,500 acres at the foot of the Rocky Mountain Rampart Range near Pike's Peak
Present Cost per Graduate $500,000

Hollywood-Designed Uniforms
Chapel & Administration Background Structures

Cadet William Patterson

Vandenberg Hall
Quarters for 2,400 Cadets

F-100 Mach One Club
World's First Production Supersonic Aircraft

Zero Gravity Club
KC-135 Modified for Astronaut Training

Academic Building & Dining Hall
Academic Class Size 15
Simultaneous Dining for 2,400

Congressional Appointment Major: Military Management FBI Clearance: Secret
Dean's List Commandant's List Superintendent's List
Total Semester Hours: 159 Grade Point Average: 3.4/4.0 Class Order of Merit: Top 15%
Highest Rank: Cadet Captain (Served as Element Leader, Guidon Bearer, Flight Commander)

Intercollegiate Sports: *Soccer, Track & Field*

Intramural & Physical Education Sports*: Football, Water Polo, Swimming, Boxing, Wrestling, Martial Arts, Gymnastics, Handball, Squash, Tennis, Fencing, Unarmed Combat.*

Military Physical: *Obstacle Course, Paratrooper Training, Physical Fitness (5BX, XBX), Formation Running, Squadron Drills, Wing Parades, Inspections, Double-Time & March (11 mo.), Zero Gravity, High-Altitude Chamber, Water Crash Survival, Mountain Crash Survival (1 wk.), Jet Flight (T-33, F-100), .38 Caliber Hand Gun Qualification (Marksman), M-1 Rifle (Carry, Care, Qualification), Automatic Rifle Qualification (BAR).*

Regimented Lifestyle Benefits: *On-Time All Classes & Formations; No Sickness, Injury, Prescriptions, or Hospitalizations. Furnished Medical Immunizations and Periodic Dental Care.*

Intended Service: M.B.A. (U.C.L.A.) & Human Factors R&D (AFSC61BX) USAF & NASA

Regular Air Force Context: Established 1947, Now Largest Air Force in the World, Present Budget $161B (28% of DOD Budget), Present Military Manning 318,000, Expended 1947-2018: Over $5T
NASA Aerospace Context: Established 1958, Present Budget $18B, Present Manning 17,000, Expended 1958-2018: $526B

Turtle Creek School District
(Municipal Population 10,000)


Electric Plan Grade School


Turtle Creek High School


Penn Avenue Middle School

Academic Degree 1961 with Honors
Salutatorian (Top Male Graduate)
Accelerated Math Program
Middle School & Varsity Sports
One of Two Interscholastic Athletes Lettering in Football, Basketball, Track & Field
Football (2-Years) Senior Co-Captain (3 college scholarships)
Track & Field (6 Years) Achievements
Middle School Broad Jump Record
Varsity Regional Honors: Mile Relay and Broad Jump
Fellowship of Christian Athletes
Class Officer
Honor Roll
Student Government
Library Club
American Legion Leadership Award
Percussionist: Marching Band, Concert Band, Orchestra
Non-Scholastic Percussion:
Wilkinsburg Civic Symphony (WLOA Broadcast)
Dance Band
Rock Band (WQED-TV Appearance)

Academic

Research, Teaching, and Service
1984-1993

Business Policy teaching and research.
Associate Professor, Assistant Professor, Instructor
Six Western Pennsylvania Institutions of Higher Education

University of Pittsburgh
Established 1787
Undergraduate Enrollment 19,000
Campus Acres 145
Four-Year Cost $120,000 (in State)

Indiana University of Pennsylvania
Established 1975
Undergraduate Enrollment 11,000
Campus Acres 174
Four-Year Cost $83,000 (in State)

California University of Pennsylvania
Established 1852
Undergraduate Enrollment 5,500
Campus Acres 294
Four-Year Cost $105,000 (in State)

Robert Morris University
Established 1921
Undergraduate Enrollment 4,400
Campus Acres 230
Four-Year Cost $117,000

Duquesne University
Established 1878
Undergraduate Enrollment 6,000
Campus Acres 50
Four-Year Cost $146,000

Penn State University
(New Kensington Campus)
Established 1958
Undergraduate Enrollment 1,000
Campus Acres 72
Two-Year Cost $63,000 (in State)

Contract Consulting Service While in Doctoral Program
NASA Innovative Advanced Concepts (NIAC)
NASA-funded partnership with universities to seed innovation ($27 million in 10 years)
John Hennon, Pitt NIAC Director
William Pitt Union Headquarters (see below)
Project: High-Strength Lightweight Aluminum Composite Sheet (Auto Body Potential)

Contract Consulting Service While In Doctoral Program
Planning Dynamics, Pittsburgh, Pennsylvania
Strategic Planning, Market Research, Competitive Analysis, and Training
Serving Pittsburgh Area Since 1986
Colin Hershey, President
Project: Automotive Fuel Vapor Technology Diffusion (15% Fuel Savings)

Other Courses Taught in Higher Education During Doctoral Education
Statistics Operations Research Marketing Production Management
General Management Simulation Accounting

Estimate 1,500 students were personally instructed during 9 years of academic service while in the Doctoral Program at Katz Graduate School of Business, University of Pittsburgh. Prepared Research Working Papers while in the Doctoral Program at Katz Graduate School of Business, University of Pittsburgh:

Capital Budgeting: A Flexible Discount Rate Model
Strategic Decision Making: A Four-Dimensional Framework
Strategic Group Analysis of the National Football League
First Mover Advantage: The Opportunity Curve
(and others)

Boyce Campus, Community College of Allegheny County
Established 1966
Total CCAC Enrollment 43,000
Annual Student Cost $17,000
Basic Statistics Course

Allegheny Ludlum Research (Now Allegheny Technologies)
Among three largest U.S. producers of stainless steel
Rank #707 in Fortune 1,000 for 2017
Natrona Heights, Pennsylvania
Basic Statistics Course

Academic Publications

First-Mover Advantage: the Opportunity Curve
Journal of Management Studies, (30:5) September 1993, pp 759-777.

Strategic Planning and Control Systems in High Technology Firms, Doctoral Thesis,
Katz Graduate School of Business, University of Pittsburgh, 1992.

Academic Initiatives

Christian-Faith Qualification for Higher Education
Self-Paced Education
Computer-Aided Education
Excellent Grade Standard
Superior Evaluation of Educators
Classroom Video Professional Development
Electronic Publishing
Wireless Classroom
Academic Wardrobe
Free Higher Education
All Season Campus
Petro-Free Campus

Industrial

Aluminum Company of America
Alcoa Technical Center
1,100 Scientific and Support Personnel on 2,400 Acre Complex
1966-1983

Aluminum Company of America was founded in 1888 as The Pittsburgh Reduction Company by Charles Martin Hall, a Presbyterian Minister and inventor of the Hall Process still used to win aluminum from its bauxite ore. Alcoa is historical leader of the U.S. Aluminum Industry and presently is a Fortune 500 Company (#300) with Total Revenues of $12B.

Associate Planning Analyst
Planning Analyst
Technical Planning and Technology Forecasting Group

Forecast advancing aluminum use in automobiles
Publication*:* Technological Trends in the Auto Industry and Their Impact on Aluminum Usage
Technology Forecasting and Social Change, 18, 205-216 (1980), Elsevier North Holland, Inc.

Analysis of R&D accomplishments and patent productivity
Publication: Evaluating R&D Performance at Alcoa Laboratories
Research Technology Management, 26(2), pp.23-27, March-April 1983.

Natural aluminum applications assessment
Food Can Packaging Market Electric Vehicle

Corporate technical innovation research
Aluminum Easy-Open End

Senior Development Engineer
Development Engineer
Metalworking Division
Alloy Technology Division
Surface Technology Division.

Less-expensive, lighter-weight automotive trim; Superior energy-absorbing bumpers, Aluminum-intensive vehicle for greater safety and superior fuel efficiency; Electric automobile alternative to pollution-intensive, petro-powered vehicles facing limited fuel future; Reflectors for office lighting and exterior illumination; Perpetual metal stream containers for beverage and food; Energy-Efficient Heat-Treating (Annealing) of Rigid Container Sheet (largest volume aluminum product) and high-strength aluminum bumper alloys (leading aluminum application for light-weighting automobiles), Aluminized steel for superior outdoor corrosion resistance and high-temperature oxidation resistance; Cookware beautification and non-stick easy-care cooking surface; aluminum and steel fasteners with improved machining and corrosion characteristics.

Engineer Publications

Optical Characteristics of a Prefinished Aluminum Reflector Sheet for Lighting
Lighting Design and Application, June 1976, pp.50-52

Batch Hot-Dip Aluminizing (with James E. Hall) *Society of Automotive Engineers,* Technical Paper 700448, pp. 1589-1595.

Standard Specification for Hot-Dipped Aluminum Coatings on Ferrous Articles
ASTM Designation A 676-72, 80 (Task Force Chairman)

Loose Abrasive Finishing of Aluminum Powder Metal Parts
Product Finishing, circa 1970

Business

Corporate Strategy Consultants
Serving Those Who Serve Society Through Technology
Founded 1986
President

Strategic management consultancy specializing in environmental analysis, strategic planning and control systems, and strategic decision making. Began as a home-based business headquartered at 47 Hauck Drive, Pittsburgh, Pennsylvania 15235 (see below, top left) and temporarily expanded to Century City, California, 1999 Avenue of the Stars,

Suite 2800, Los Angeles, CA 90067 (below top right). At the peak of America's petro energy crisis, market development of original, green stream (perpetual) energy processes was mobilized via personal sedan and motorhome modified to an Office on Wheels. Designated the Momentum Tour, more half the United States were visited to communicate a Vision of the Future for energy independence within each State to assuage growing fear about survival of petro-dependent nations.




Vehicle images above are close approximations of Dr. Patterson's Momentum Tour package of 1996-1997

Corporate Strategy Consultants Products & Concepts

Strategic Management of Business Organizations (book)
Fee-Less Dollar Stocks
Advancing Artistry
Dyadic Management
Humanized Productivity Enhancement
Batch Audio Messaging
Organizational Entropy
Organizational Free Energy

Organizational Critical Mass
People-Systems-Technology Model
The Human Organization

Executive Software Suite for Top Management.
Pyramid Strategic Planning and Control System
Industry Analysis
Risk Analysis
R&D Portfolio Management
Dialectic Decision Making

Spreadsheet Suite for Strategic Management
ABC Activity Management
ABCD-SWOT Analysis
Data Conditioning
Decision Analysis
Generic Strategy Grid
Growth-Share Matrix Analysis
Hierarchical Management Control
Hierarchical Stakeholder Analysis
Industry Structure Analysis
Macro Trend Analysis
Niche Analysis
Opportunity Curve Analysis
Pattern Stability Analysis
Product Attribute Analysis
Product Life Cycle
People-Systems-Technology Screen
R&D Budget Optimization
Relevance Analysis
Service Stature Analysis
Seven-S Analysis
Stability Analysis
Strategic Elasticity
Tech Advance Forecast
Two-Dimensional Financial Analysis

Visionary Enterprises
Creative Business Venture Concepts
Founded 1995
Director

Developed hundreds of innovative products and processes to raise the quality of life in product-market areas spanning the American lifestyle spectrum.

Comfort Tools	*Mountain Air Home Respirator*
Restaurant Dental Station	*Church Table Dating*
Auto Radio Phone	*Seven Rings of Marriage*
Earthquake Stress Relief	*A'Naturale Shave*
Luxury Auto Pool	*Bio Shrimp Farming*
Office Home	*Budget Checks*
Daily Body Care	*Neck Toner*
Refresh Break	*Life Card*
George Cookware	*Car Wash Artistry*
Hour of Power Business Luncheon	*Circle of Friends*
Audio File Abstraction	*Humor Break*
Speed Cycling	*Office Equipment Refinishers*
Radiation-Free, Monitor-Free Micro-Processor	*ThumBall Computer Screen Control*
	Green Fitness
Family Cargo Truck	*Endless Pencil*
Custom Selection Music Albums	*Mon Car*
Riverboat Vacations	*Tropic Light House*
Multicultural Cities	*Stage Coach Trailers*
Universal Free Cellular Phones	

Society

Societal Policy Group
Public Policy for the Great Society
Founded 1995
Director

Solve national and international problems facing society and raise the general quality of life. Originated new energy production processes to support society in the post-petroleum era. Designed life-saving systems for energy-efficient food production and human transportation.

Perpetual Energy Resource Development Initiative

LeaFuel RiverPower HydroCool Power Cascade Orbiting Solar Power Station
Hybrid Solar Collector Solar Farming Oceaneering
Low-Velocity Wind Energy Fences VAWT Suburban Wind Trees
HAWT Urban Wind Trees

Food Resource Development

Eagle Garden Giant Shrimp Farming Eco-Fit Landscaping/Protein Landscaping
Urban Cows & Chickens Topsoil Saver

Transportation Continuity Initiatives

Double Eagle Bus Armado Scientific Personnel Carrier Glass Slipper Roadster
Rail-Link Electric Campus Campus Cities Sun Limousine Mon Limousine

Emblematic Transportation Initiatives

Metal Vette Eagle Tradition Father Ferarri Eagle Cycle

Governmental

Strategic Statesmanship Planning Humanized Productivity Enhancement
Western Whitehouse Office of the President of the United States
Safe Ways Free-Fair Trade Programming Great Society Rights and Freedoms
Super Rangers Non-Lethal Weapons Technology Natural Defense Training

The Arts

Bill Patterson Vocalist and Composer (Founded 1971) Compose, perform, and record music and music videos of faith, patriotism, love relationships, nature, and character. Over 100 original music compositions created. Design special music events, and originate technology for music performance, including instruments of musicianship.

Special Events

Very Special Event Country America Rock America Perfect Ten

Music Technology

Glamour Speakers Octagon Speakers Wireless Sound Management
Low-Energy Sound Reinforcement and Staging Golden Synthesizer
International Guitar Nesting Drum Set Briefcase Vocal Artist Voice Box

Songs and Music Videos

Let Jesus be the Center of It All Think on These Things Happiness
Love the Little Children Bread and Water I Am Love
Good News Count On Me Friends Just Treat Me Right Sweet Virginia
Golden Rule Love Women Who Loved Men Like Me Africa Tan

Real Men Right Side Livin' Time Red Hair Chasin' Money 77 Ways
Material Men Sugar Island Midnight Phantom Ride With Me Green Colors
Painted Fish Flowers Have Your Seen Me Lately Yours Truly Mary
Each One Baby Blue Jean Baby Press On Pleasure Tyrant Soldiers of Light
Alive at Thirty-Five Tahiti In The Spirit Sweet Fitness High-Minded Lady
It's Me A Hundred Years Ago A Man Named Ray Affairs of the Heart
Centurian Great Asia Great Waters Powered By God River Life Grace
Charity Roses of Mexico Spanish Dancer Little Woman I Remember Mama
Kelly Lady of Truth Love A Million Ways Love Conversation Mr. Rockwell
Nature Harmony Over and Under This Guitar Soldiers of Heaven
Time Is Slippin' Away To The Praise of His Glory Treasure Children
Hold Your Head High Down On The Farm Dream Walk Each One
Happiness Commander Jewess Bells of Heaven Apache High Blues of St. Louis
Coffee Petite Creole In The Shade Marvelous Zion Office Cows
Promises to Keep Twelve Ordinary Men Mission Impossible Red
Rock & Roll Salvation Deeper Shade of Green Good Green Earth
Songs From Glory Pathway to Heaven A.M. Man Mary, Mary, Mary
A-Train Green Cycle Blue Dawn Presence To Fly Right On
The Highest Dove World of the Sea Shalom GeoForce Service Song
Call the Captain Great Russia Music is a Lady New York City Woman
I'm On Fire Steel Theatre Steel River

Arranged Music Compositions and Music Visions

This is My Father's World Laughter From the Heart
Song of Marie My Little Marie Naturally Free Mexico Tropic Light
Sacrifices of Joy Green Life Simple Life Heaven's Playing Basketball
Rendezvous of Love

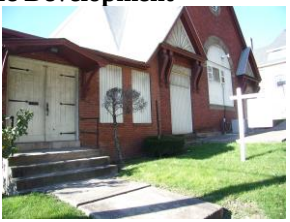
Literature Compose motivational literature, poetry, and film projects to enrich life.

High Flight
Free Energy
The Gem
City of Love
Pyramid Reflections
Victory Over the Pleasure Tyrant

Churches Instrumental to Personal Christian Life Development

First Reformed Presbyterian Church
Penn Hills, PA

Electric Heights Methodist Church
Turtle Creek PA



First Presbyterian Church
Turtle Creek, PA
(inactive original location)

USAF Academy Chapel
Colorado

First United Methodist Church
Colorado Springs

Hillcrest
United Presbyterian Church
Monroeville, PA
(relocation from T.C.)

The growing demand to satisfy pressing human need via enlightened leadership through Christian ministry and service to society is opening pathways for counsel within the Church, industry, and society at an international scope. Every professional involvement of Dr. Patterson is supportive of this vital mission, inasmuch as the value systems behind motivation, work, and performance in every society are under stress and scrutiny in the Third Millennium.

Importance of the Christian Religion to person, nation, and world is chronicled in life experiences of Dr. Patterson. Considerable personal hardship was experienced in arriving at the professional peak of career and service to God and man. Most adversities were the result of inroads by veiled crime and prejudice into American life that had the net effect of cutting back the culture, influence, and presence of Godly men. Such blind demotion of worthiness ascribes primarily to failure in maintaining the Most Holy Christian Faith as centerpiece of American life. Indeed, the Holy Scriptures clearly warn of the burdens laid upon righteous gentlemen when trials and corruption beset the nations. The Apostle Paul, a persecutor of the Church turned chief Apostle for evangelism to the gentiles (a ministry vacated by Israel), testifies to the nature of personal sacrifice Saints bear when God's will is not obediently served:

Are they ministers of Christ? . . . I am more; in labours more abundant, in stripes above measure, in prisons more frequent, in deaths oft. Of the Jews five times received I forty stripes save one. Thrice was I beaten with rods, once was I stoned, thrice I suffered shipwreck, a night and a day I have been in the deep; In journeyings often, in perils of waters, in perils of robbers, in perils by mine own countrymen, in perils by the heathen, in perils in the city, in perils in the wilderness, in perils in the sea, in perils among false brethren; In weariness and painfulness, in watchings often, in hunger and thirst, in fastings often, in cold and nakedness. Beside those things that are without, that which cometh upon me daily, the care of all the churches. Who is weak, and I am not weak? who is offended, and I burn not? If I must needs glory, ***I will glory of the things which concern mine infirmities****. 2 Corinthinians:11.23-30*

When God's people are in distress, as they are today, and as is the world He so loved, there is Spiritual validity in credentials that bear the battle ribbons of sacrifice. Our Lord helped those in greatest need in His time, and we are wise to do the same. The Christian does not sacrifice others to live; he bears other's burdens and helps to lift them up in the power of God. Someday, those now downtrodden will see what they had to give up as a gift of supply to others that they might survive; and, conversely, those who have borne no burden, as having shrunk from their providential duty. We serve a God who makes us indomitable; so it is wise to consider every trial only a temporary stress on the way to eternal victory. As a scholar, my learning matures with Paul's teaching from Philippians:

I have learned, in whatsoever state I am, therewith to be content. I know both how to be abased, and I know how to abound: every where and in all things I am instructed both to be full and to be hungry, both to abound and to suffer need. ***I can do all things through Christ which strengtheneth me****. Philippians:4.11-13*

Global Christian Initiatives

Global Environmental Service
Priesthood of Science and Technology
Marie Society
Mary Society

Evangelical Christian Music Ministry (Live Performance)
(Includes Special Music for Wedding Ceremonies)
Evangelism & Spiritual Support to Churches, Senior Care, Christian Education, Marriage, Motherhood, Youth, Business, Government, Military, Social, Needy

Western Pennsylvania

First Presbyterian Church of Pittsburgh
North Side Christian Missionary Alliance Church
Mount Royal Presbyterian Church
Methodist Church Bethel Park

Western Pennsylvania

First Reformed Presbyterian Church Penn Hills
Reformed Presbyterian Church Irwin
Murrysville Reformed Presbyterian Church
Mount Hope Presbyterian Church
Electric Plan Methodist Church
McMasters Methodist Church
Hillcrest Presbyterian Church
White Oak Methodist Church
Calvary Baptist Church of Irwin
Grace Presbyterian Church Lower Burrell
Presbyterian Church of Arnold
Baptist Church of Tarentum
Community Baptist Church
Presbyterian Church (Rev. Rick Raines, SW PA)
Greensburg Full Gospel Church
Ladies of the Eastern Star (Butler)
Presbyterian Church Pitcairn
Grove Presbyterian Church
Turtle Creek Episcopal Church
Riverview Presbyterian Church
Oakmont Methodist Church (Rev. Jones)
Jack Levine Christian Ministry (Squirrel Hill)
Murray Manor (Murrysville)
Presbyterian Home (Wilkinsburg)
Oakmont Residence
Carnegie Hall (Oakland)
Zoar Home for Unwed Mothers
Pittsburgh YMCA
Youth Guidance
Storehouse of Love (Liberty Avenue)
Pittsburgh Market Square
Christian School of Wilkinsburg
Lake Erie Youth Camp (NW PA)
Subaru Christmas Celebration (NW PA)
Duquesne University
Holiday House

Georgia

Full Gospel Church of Atlanta

Central Pennsylvania

Treasure Lake Community Church

Pittsburgh First Presbyterian Church

North Side
Christian Missionary Alliance Church

Electric Heights Methodist Church

Holiday House Supper Club

First Baptist Church Nashville

Nashville
First Baptist Church

New Jersey
Harvey Cedars Bible Conference

New York City
Street & Hotel Evangelism

Pentagon

Washington D.C. Area
Pentagon Concourse
Alexandria Baptist Church

Live Performance Sacred Music Titles
At the Cross
Turn Your Eyes Upon Jesus
America The Beautiful
Jesus Loves Me
Get All Excited
I Just Feel Like Something Good Is About to Happen
It is Well with My Soul
Sweet, Sweet Spirit
The Lord is My Light
Through it All
Redemption Draweth Nigh
Redeemed

Got Any Rivers
This Little Light of Mine
There's Just Something About That Name
The Lord's Prayer
The Holy City
Welcome Home Children
I Believe in a Hill Called Mount Calvary
Wedding Song
Song of Ruth
How Great Thou Art
Bethlehem Morning
My Tribute
We Shall Behold Him
Names of Jesus
It is Finished
Wonder of it All
They Could Not
There is a Quiet Place
The King of Who I Am
The Blood Will Never Lose Its Power
Sweet Little Jesus Boy
Rise Again
New Twenty-Third
He Was There All the Time
Come Thou Fount of Every Blessing

Authored Nashville Productions Performed Live
Let Jesus Be the Center of it All
Happiness
Think On These Things

Private Life

Active in the Christian faith, proponent and practitioner of work-to-live ethic, servant to the church at large, minister in music, leader and promoter of Bible study and spiritual edification, patriarch of youth development, minister to the needful, and proponent of family-centered living. Practice and innovate physical fitness and health-enhancement initiatives as costless universal healthcare that invokes the Great Physician for sustained beauty and vitality, gradually eliminating need for remedial or emergency care as we enter a tearless, peaceful, prophesied millennium of heaven on earth.

Progressive Bible Study Spiritual Inquiry for All Faiths
Led Bible Studies at home & industrial workplace
Taught adult Sunday School, Devotions leader for young couple's club,
Taught Teen Sunday School, Led Church Youth Group
Church Choir: Member and Soloist
Board of Directors: Trinity Christian School
Church Trustee Board: Manage financial affairs of expanding Church
Church Worker: Vacation Bible School, monthly dinner service to handicapped & street people,
Sunday visitations to shut-ins
Christian School Worker: Lunch service to Christian School students,
Christian School facilities cleaning & painting
Evangelism Explosion: Weekly Gospel visits to community move-ins
Sidewalk Evangelism: Monroeville Mall (for Christian Education), Penn Hills Shopping Center
Universal Life Furniture & Interior Design Economical, Energy-Efficient Customization
Green Fitness Free and Natural Physical Fitness Program
Light Health Indoor Sun for Home and Office
Green Air Indoor Air Quality Enhancement via House Plant Foliage
Podiatric Floor Treatments Hyper-Cushion Key Stand-In Rooms (Kitchen, Bath)
Christian Land Transportation Initiative: *MonCar, Solo, Solar Salon, LifeWay*
(very-low-cost, petro-conserving, lifetime, safe, singleton & family transportation)
Christian Water Transportation Initiative:
Environmental Commander, Water Lab Cruiser, Water Lab Barge, Stiletto

Senior Charity Work

Hi-Rise Tenant Council President
Greater Pittsburgh Community Food Bank

Earliest Work Experience (Age 14-18 Summer Employment)

Churchill Country Club
Edgewood Country Club
Isaly's Dairy & Restaurant
Sun-Telegraph Paperboy
Father's Home Remodeling Business
Dance Band & Rock Group Drummer

Birth Family

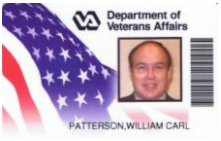
Father: *Joseph Orr Patterson*
In his teenage years, Dad was a highly successful Big Band singer in Western Pennsylvania
Mother: *Eulalia Delores (Fowler) Patterson*
In Mom's teenage years, she won the Miss Pittsburgh Bathing Suit beauty contest
Siblings in Age Order*:*
Orrlene: Housewife, Mother of four, Women's Bible Study Leader
Joseph (Jr.): Kings Point Merchant Marine Academy grad, father of four
Cathy: Practical Nurse, Minister's wife, one child
Thomas: Edinboro University grad in Communications, father of four

Military Service: *Seven Years*

United States Air Force
USAF Academy
Colorado
Air Force Officer Cadet Training
Regular Air Force Active Duty Time

United States Air Force Reserves
911th Airlift Wing
Pittsburgh International Airport
Coraopolis, Pennsylvania
1,500 Reservists, Civilians, and Contractors
Support USAF Air Mobility Command
Administrative Specialist
There are 69,000 U.S. Air Force Reservists

Honorable Discharge
1967



United States of America Under God Standards for Citizenship and Defense

U.S. Military Service Code

·I am an American, fighting in the forces which guard my country and our way of life. I am prepared to give my life in their defense.
·I will never surrender of my own free will. If in command, I will never surrender the members of my command while they still have the means to resist.

·If I am captured I will continue to resist by all means available. I will make every effort to escape and aid others to escape. I will accept neither parole nor special favors from the enemy.
·If I become a prisoner of war, I will keep faith with my fellow prisoners. I will give no information or take part in any action which might be harmful to my comrades. If I am senior, I will take command. If not, I will obey the lawful orders of those appointed over me and will back them up in every way.
·When questioned, should I become a prisoner of war, I am required to give name, rank, service number and date of birth. I will evade answering further questions to the utmost of my ability. I will make no oral or written statements disloyal to my country and its allies or harmful to their cause.
·I will never forget that I am an American, fighting for freedom, responsible for my actions, and dedicated to the principles which made my country free. I will trust in my God and in the United States of America.

U.S. Citizen Pledge of Allegiance

I pledge allegiance to the flag of the United States of America,
and to the Republic for which it stands,
One Nation, under God, indivisible,
With liberty and justice for all.

New Testament Sonship of God Service in Christ

My son, be strong in the grace that is in Christ Jesus. And the things that thou hast heard of me among many witnesses, the same commit thou to faithful men, who shall be able to teach others also.

Thou therefore endure hardness, as a good soldier of Jesus Christ. No man that warreth entangleth himself with the affairs of this life; that he may please him who hath chosen him to be a soldier. And if a man also strive for masteries, yet is he not crowned, except he strive lawfully. The husbandman that laboureth must be first partaker of the fruits. Consider what I say; and the Lord give thee understanding in all things.

Remember that Jesus Christ of the seed of David was raised from the dead according to my gospel: Wherein I suffer trouble, as an evil doer, even unto bonds; but the word of God is not bound. Therefore I endure all things for the elect's sakes, that they may also obtain the salvation which is in Christ Jesus with eternal glory.

It is a faithful saying: For if we be dead with him, we shall also live with him: If we suffer, we shall also reign with him: if we deny him, he also will deny us: If we believe not, yet he abideth faithful: he cannot deny himself.

Of these things put them in remembrance, charging them before the Lord that they strive not about words to no profit, but to the subverting of the hearers. Study to show thyself approved unto God, a workman that needeth not to be ashamed, rightly dividing the word of truth. But shun profane and vain babblings: for they will increase unto more ungodliness. And their word will eat as doth a canker.

Nevertheless the foundation of God standeth sure, having this seal, The Lord knoweth them that are his. And, Let every one that nameth the name of Christ depart from iniquity.

But in a great house there are not only vessels of gold and of silver, but also of wood and of earth; and some to honour, and some to dishonour. If a man therefore purge himself from these, he shall be a vessel unto honour, sanctified, and meet for the master's use, and prepared unto every good work.

Flee also youthful lusts: but follow righteousness, faith, charity, peace, with them that call on the Lord out of a pure heart.

But foolish and unlearned questions avoid, knowing that they do gender strifes. And the servant of the Lord must not strive; but be gentle unto all men, apt to teach, patient, In meekness instructing those that oppose themselves; if God peradventure will give them repentance to the acknowledging of the truth; And that they may recover themselves out of the snare of the devil, who are taken captive by him at his will. (*Charge from Apostle Paul to his ministerial Son in the Faith, Timothy, found in 2 Timothy Chapter 2*)

Societal Service Matrix

Key Priorities *Third Millennium*	Prep	Exp	Spirit	Background Inventory and Fit *William C. Patterson, Ph.D.*
Energy Continuity *Post-Petroleum Energy Resource Development*	95%	95%	100%	15 corporate research years advancing energy-efficient living . Entrepreneurial service in perpetual energy resource development since 1995.
Food Adequacy *Global Population Support Under Logistical Stress*	65%	75%	100%	Corporate pioneering of light-weight food containers since 1976. Singleton research in high-tech food gardening since 1997.
Water Quality and Adequacy *Potability Maintenance and Fair Distribution*	55%	85%	100%	Corporate tech experience in water purification 1966-1976. Singleton R&D in hydromanagement & technology since 1997, Rio Alto design for Mexico.
Transportation Continuity and Safety *Post-Petroleum Automobiles and Safe Roadways*	95%	95%	100%	Corporate and personal development work in all forms of transportation for improved energy efficiency and safety throughout career.
Atmosphere Quality Maintenance *Ozone Restoration, Acid Rain Relief*	95%	85%	100%	Corporate tech experience in air quality management since 1966. Individual initiatives for better air quality include novel auto muffler designs, electric transportation alternative designs
Civility/Spiritual Maintenance *Prejudice, Crime, War Avoidance During Energy Transition*	85%	95%	100%	Christian initiatives in youth leadership, music evangelism, Christian education board service, statesmanship plans, Spiritual counselorship, Great Society Rights and Freedoms, Global Environmental Service, and Priesthood of Science and Technology.
Health and Beautification *Preventive Healthcare and Personal Fitness*	95%	95%	100%	Refresh Break (1997), Green Fitness (2000), Marie Fitness (2005), Mary Fitness (2006), Light Health (2006), Residential/Office Air Quality (2005)
Youth Development *Spiritual and Intellectual Preparation for Peace Leadership and Service*	85%	95%	100%	Vision Step (1996), Marie Society (2004): Christian training for developmental males and females.
Advancing Artistry *Elevating the Arts to Centerpiece of Societal Life*	95%	85%	100%	Christian Music Ministry since 1971, Strategic Management of Business Organizations (book)
Totals	85%	89%	100%	**91%**

Influencing figures of the Societal Service Matrix are a few conditioning and restrictive indices. Regarding Intelligence Quotient as fitness for problemsolving, mine is in the top 0.016% of the population. Educational level is in the top 0.2% of the U.S. population, and 0.03%-0.2% of the global population. Marriage of technical education (engineering at 2% of the U.S. population) and strategic management education (about 2,000 such Ph.D.s world-wide) creates an education composite in the range of one-in-a-billion. Statistics on incidence of faith in Jesus Christ matured to the re-born (love of God) level are not easily known, but likely less than 1%. Non-telepathy, a quality heretofore under attack and waning in representation among world populations has left what used to be a global majority (50%) now less than 20% of the global population. Those prepared by God in Christian nations (via religious education and service) are of even lower incidence now (less than 4%), although the USA is a product of Christian culture and generation. Properly understood as God's holy men, prophets, high (anointed) priests, and Saints, the very small number adequately prepared to serve America at this time appears to be at an all-time low. Merciful in this matter is evidence from Biblical history that few servants 100% committed to God need be chosen by Him to do great saving works.

Emergently evident in the above review of mind attributes and development at this time of global society maturation are qualities of *rarity* and *uniqueness* among knowledge elites, wisdom cultures, executive leaders, experts, skill masters, creatives, inventors, etc. Comparison & competition, envying & out-racing are common, but the headship of modern times is becoming evermore stand-alone, one-of-a-kind personage. Our God is one and matchless. So, we might reasonably assume that becoming more like Him, as He orders us to do, will produce an advanced world of highly unique and fascinating characters, ultimately incomparable, and admirable in diverse and divine ways.

The Global Environmental Service envisions 50,000 Priests of Science and Technology (including families) serving at headquarters around the world. Though much smaller in number than the world's 21 million men in arms today, they represent a body for peace much larger than our Lord gathered in Apostleship with great, though patient, success. The modern convocation of Priests would be less than 0.3% of all U.S. Ph.D.s, (now about 6 million) and less than 0.08% of all U.S. science & engineering talent (now about 20 million). Since the Global Environmental Service Priesthood of Science and Technology directly serves the Prince of Peace, our Lord and Savior Jesus Christ, it represents a Global Peace Investment of 50,000 non-combatant, non-destructive families with maximal potential to eliminate the Global War Investment of perhaps 100 million military families serving in harm's way. The ultimate Peace Leverage is considerable: investing in one GES Priest Family foregoes investment in 2,000 worldwide War Families and consequential collateral damage. It also should be kept in mind that enabling one befriending missionary family for overseas service costs much less, perhaps 80% less, than equipping one solitary combat solder for overseas service.