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Engineering a Leader – Technical Career Paths to the Executive Suite

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Engineering a Leader – Technical Career Paths to the Executive Suite

by

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Dedication

To my children, may this document be an inspiration to both of you in completing your education. Just do not take as long as your dad did.

Acknowledgements

First I would like to thank my wife for keeping me on task, and helping to control my desire, to place commas, in sentences, where they do not belong. To my mother for stressing the importance of education into her son and to Christopher Barron, former Senior Vice President and CIO of CPS Energy, for being my mentor and encouraging me to undertake this Master's degree.

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Abstract

Engineering a Leader – Technical Career Paths to the Executive Suite

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This thesis will identify what career paths, advanced degrees, and supportive industries best enable engineers and other highly technical professionals to move past middle management layers into executive leadership. Specific questions to be addressed include:

1. Which technical degrees most often lead to CEO appointments?
2. Which industries offer the most advancement opportunities for technical degree graduates?
3. Which advanced degrees are most useful for ascension into CEO ranks?

This research is specifically geared to extend the key learnings of the University of Texas at Austin Executive Engineering Management curriculum giving the reader foresight into what executive career paths are available for those with technical degrees.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

A recent popular press book by Marshall Goldsmith entitled *What Got You Here Won't Get You There* features a picture on the front cover of a person in a business suit stretching to reach across a number of missing rungs in the hypothetical corporate ladder but unable to cross the gap. Although the premise of the Goldsmith book (twenty workplace habits you need to change to be more successful in your current role) does not align with this thesis, its title and the "missing corporate ladder rungs" graphic are an excellent visual introduction to purpose of this document.

The Bureau of Labor Statistics Occupational Employment Statistics (OES) Survey completed in May 2008 provides data to reinforce this visual metaphor. It stated that one out of every 25 employed nationally progress to management occupations but only one out of 500 has been able navigate across this gap into chief executive roles[1].

This thesis will identify what career paths, advanced degrees, and supporting industries best enable engineering managers and other highly technical management professionals in their progression to the highest levels of executive leadership. A key premise of this thesis is that the technical and analytical capabilities that have helped these mid-level employees to the top of the technical management ladder leave them ill-suited for the executive ladder just out of reach. This thesis will identify what those missing ladder rungs are by investigating related research works, examining the suppositions made in current business literature, and by conducting primary research into

[1] http://www.bls.gov/oes/current/oes_nat.htm

the career paths of highly technical professionals who have crossed over into the highest levels of the executive ranks.

The research will culminate in the development of a methodology for creating more effective career paths for engineering and other technical science managers that will help identify the steps needed to enable executive level careers. Specific career path examples for Engineering Managers and Information Technology Managers will be presented to guide the reader in the application of the methodology for other technical management occupations. Key questions to be addressed by this thesis include:

1. Which technical degrees most often lead to CEO appointments?
2. Which industries offer the most advancement opportunities for technical degree graduates?
3. Which advanced degrees are most useful for ascension into CEO ranks?

Chapter 2, Literature Review, will discuss selected academic papers related to chief executive functional background, personality, and typical career paths. Private sector research data has been gathered from the executive consultant firm of Spencer Stuart[2] which has collected survey data from 500 CEOs for a number of years. Finally a number of government research data will be presented, including data from the Department of Labor, Bureau of Labor Statistics, and the Texas Workforce Commission.

Chapter 3, Study Methodology, will detail the manner in which additional information was gathered to meet the thesis objectives. It details how the study's targets

[2] http://www.spencerstuart.com/research/articles/

were selected, and how the primary research was conducted. Much of the base data came from government sources, but information on chief executive functional backgrounds had to be gathered in order to develop the career path methodology mentioned previously.

Chapter 4, Results, will provide narrative on the key findings of the research conducted. The key data trends will be identified and summarized in preparation for the final chapter, Conclusions.

Using the data gathered from all sources, the fifth and final chapter culminates with the presentation of the developed career path methodology with two example mappings provided. It also addresses the key thesis questions presented on the previous page.

Chapter 2: Literature Review

The research that was conducted for this thesis included an examination of a number of popular press publications and academic journals and has been organized under three central themes involving chief executive functional backgrounds, their career paths, and personality characteristics. By investigating this state-of-the-art research against the objectives of this thesis, areas of focus will be identified to help determine which of these factors may be predictors of success for CEOs with technical education and career backgrounds.

FUNCTIONAL BACKGROUND

The first central theme, functional background, focused on the study of post-secondary education for CEOs and senior managers, and the industries they serve. The emerging importance of CEO international experience will also be researched. The most useful source for investigating these items was from executive search and consulting firm, Spencer Stuart[3]. This research is significant as it includes a large sample size of 500 top CEOs based on S&P 500 and Fortune Magazine's rankings.

Undergraduate Fields of Study

One of the key findings of the Spencer Stuart study suggests that having an engineering background may be helpful in the pursuit of a Chief Executive Officer position. The following tables provide a summary of the Spencer Stuart findings of the most frequent educational backgrounds of the 500 CEOs in their study. However, further

[3] http://content.spencerstuart.com/sswebsite/pdf/lib/2008_RTTT_Final_summary.pdf

examination of these results show the business related degrees of Economics, Business Administration, and Accounting total to represent 38% of the study CEOs.

Table 2.1: Undergraduate Educational Backgrounds – Spencer Stuart

500 CEOs Undergraduate Degrees	Percentage
Engineering	22%
Economics	16%
Business Administration	13%
Accounting	9%
Liberal Arts	6%

Alignment between Fields of Study and Industry

Another interesting data point in the Spencer Stuart study was the variance in educational background by industry. Naturally, engineering degrees dominate the manufacturing sectors averaging 42% of the undergraduate degrees and to a somewhat lesser extent in the Mining and Utilities industries, averaging 27%.

A 2002 Barker and Mueller study on CEO characteristics as they relate to innovation support this discovery. They found that CEOs with science and engineering related degrees invest more in research and development than their business degree counterparts (Barker, 782). They also pointed to a 1984 study by Scherer which showed that certain industries showed a higher propensity to invest in R&D (Barker, 784). The results of these studies might suggest a possible alignment between certain industries and CEO candidates with technical degrees.

Graduate Level Backgrounds

Although the Spencer Stuart study provided a detailed breakdown of undergraduate degrees, the following table of graduate degrees had to be derived from the limited information provided. It should also be noted that these numbers do not add up to 100% due to the fact that not every CEO studied had a graduate degree and some had more than one graduate degree. The percentages represent the total number of graduate degrees awarded to the population of 500 study participants.

Table 2.2: Graduate Level Educational Backgrounds – Spencer Stuart

500 CEOs Graduate Degrees	Percentage
M.B.A.	39%
Other Masters Degree	14%
Law Degree	10%
PhD	4%

The MBA is clearly the preferred graduate degree but this thesis will determine if the subset of CEOs with technical degrees share the same affinity to the MBA.

Senior Manager vs. CEO Education Profiles

Useem and Karabel completed a complementary academic research study into the educational backgrounds of senior executives in 1986. This study looked into the social, scholastic, and career experiences of 2,729 senior managers (vice president or higher) representing 208 large US based corporations and found 3 major factors for facilitating career ascent into the highest executive ranks (Useem, 184). They are:

1. Possession of a bachelor's degree from a top-ranked college, a master's degree in business administration from a prominent program, or a degree in

law from a leading institution.

2. Controlling for educational credentials, an upper-class background increases the likelihood of rising to the top ranks of corporate management.

3. The impact of a law degree and an upper-class origin are most pronounced for successful movement beyond the firm into formal and informal inter-corporate networks (Useem, 184).

In addition, undergraduate degrees were evaluated against a ranking of eleven top institutions, which are primarily known as Ivy League schools, in the nation in 1940 as defined by Coleman (Useem, 187). This year was selected because it represented the freshman year in college for the average executive in the 1986 study. A similar list of eleven elite MBA and nine prominent law degree programs were independently defined by Useem and Karabel. The following table summarizes their findings on executive educational background (Useem, 188):

Table 2.3: Senior Executive University Backgrounds – Useem & Karabel

University background (n=2729)	Percent
No college/ no degree obtained (452)	16.6%
BA only, unranked college (753)	27.6%
BA only, top college (306)	11.2%
MBA, unranked program (81)	3.0%
MBA, top program (385)	14.1%
Law, unranked program (274)	10.0%
Law, top program (203)	7.4%
Other post-graduate degree (275)	10.1%

These results reiterate the importance of higher education for senior executive roles but also show that college ranking is less a factor for undergraduate degrees as it is for MBA programs. The study also supplied a breakdown of the percentages of the

population which were chief executives for five of the eight categories shown in table 2.3. Using this information, the following statistics were derived to provide a baseline that will be useful for a study into chief executives exclusively. Information regarding MBA, unranked program, Law, unranked program, and other post-graduate degree information was not available.

Table 2.4: CEO University Background -- Useem & Karabel

CEO University background (n=1062) – 38.9%	Percent
No college (77)	26.5%
BA only, unranked college (274)	36.4%
BA only, top college (158)	51.6%
MBA, top program (173)	44.9%
Law, top program (92)	45.3%

These results show an advantage for CEOs obtaining an undergraduate degree from a top college (with 51.6% achieving CEO status) over an executive who does not have a top undergraduate degree but does have an MBA from a top program (44.9%). Finally for the purposes of this study Useem and Karabel state:

> Originating in an upper-class family has a positive effect on the careers of senior managers independent of all other variables. This effect is not statistically significant for ascent within the firm to the status of CEO, but coming from a patrician background does confer important advantages in gaining access to positions of leadership outside the firm (Useem, 197).

International Experience

Another interesting piece of information gathered from the Spencer Stuart study was the increasing significance of international work experience in which 34% of CEOs worked overseas or managed an overseas facility up from 26% just five years prior. This

is an emerging factor of significance related to the globalization of market economies. However, at what career stage these international assignments occurred could not be determined.

CAREER PATH

The second central theme of the literature review involved the identification of models for examining executive career paths. In particular this author is interested in examining the differences in the two technical career paths, engineering and information technology (IT) professionals. Analysis of occupational Knowledge, Skills, and Abilities required among the various stages of a career path will also be examined.

Career Path Model

The most relevant research model found came from the Hambrick and Mason developed concept of career path profiles (CPP) which was created as a part of their Upper Echelons Theory (Hambrick, 719). The CPP is comprised of 4 major components:

1. Functional tracks
2. Insider / outsider status
3. Formal education
4. Age

Functional tracks are broken into two categories, output functions, and throughput functions. Output functions are focused on enabling the growth of the organization through roles like marketing and sales, and the identification of new opportunities

through functions like product research and development. Throughput functions focus on the efficiency of the internal process to produce the goods and services. Examples of these roles include production, manufacturing, and operations. This study will determine which of these functions are more prevalent during the executive stage of tech CEOs' career paths.

CEO Functional Tracks

The Spencer Stuart study provides key insight into the functional tracks of these CEOs by collecting past roles. It is important to note that the survey question was phrased so that respondents provided information on past roles but, in general, it did not collect any sequencing data with the sole exception of the role they served just prior to becoming CEO (shown in the second table).

Table 2.5: CEO Past Functional Roles – Spencer Stuart

Past Functional Roles (any stage)	Percentage
Operations	42%
Finance	31%
Marketing	24%
Sales	17%
Engineering	11%
Planning & Development	9%
Law	7%
Consulting	4%
Banking/Investment Banking	3%
Academia	1%

The Spencer Stuart survey only reported the top 4 functional roles served just prior to becoming CEO which totaled 70% of the responses. The survey did not include

detail on what roles make up the remaining 30% and did not describe what functional roles are combined to create the "General Management" category. The research conducted as a part of this thesis will attempt to capture the information that could not be gathered from this source.

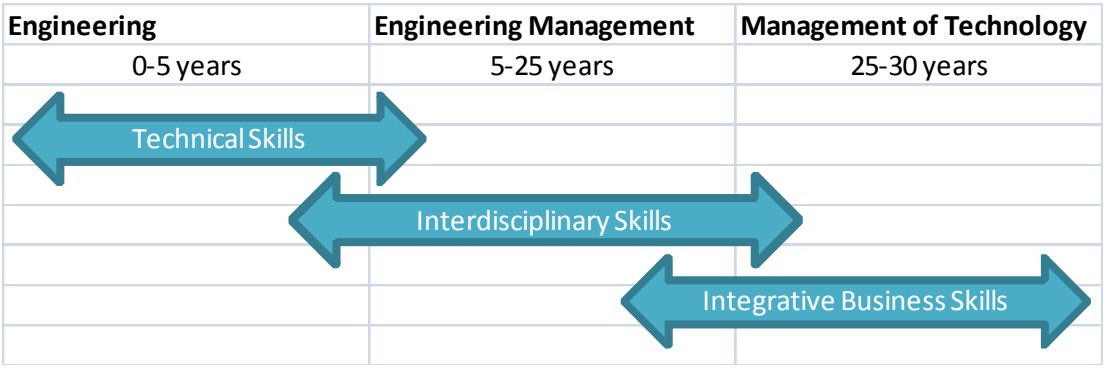
Table 2.6: CEO Just Prior Functional Role – Spencer Stuart

Functional Role Just Prior to CEO	Percentage
Operations	31%
Finance	21%
Marketing	12%
General Management	6%
Other	30%

Engineering Career Paths

The typical career paths of engineers are well studied and Lannes provides an excellent diagram to illustrate the three overlapping career phases for engineers following the management path as shown below. During the Engineering phase, application of learned skills and the development of additional technical skills through mentoring are prevalent. The Engineering Management phase represents a transition from problem solving skills in a specific engineering discipline to interdisciplinary skills such as project management, organizational, and interpersonal skills. The final phase involves a wider focus on organizational and industry issues typical of executive roles (Lannes, 109).

Figure 2.1: Typical Engineering Career Phases



The transition from the technical engineering phase to the management phase is further defined by Lannes as follows:

> The engineering manager is distinguished from other managers because he [or she] possesses both an ability to apply engineering principles and a skill in organization and directing people and projects. He is uniquely qualified for two types of jobs: The management of *technical functions* (such as design or production) in almost any enterprise, or the management of broader functions (such as marketing or top management) in a *high-technology enterprise* (Lannes, 107).

Lannes also introduces the concept of dual (technical and management) career paths with the technical path being mainly found in high-technology enterprises (Lannes, 108). The participants on the technical track received rewards and career advancement opportunities on par with their counterparts in the management track (i.e., engineer-manager-executive) but stay focused on specific technical skills that are core with the organization's mission.

Tremblay, Wils and Proulx in their study of the career path preferences of 900 Canadian engineers identify three additional engineering career paths; project, hybrid, and entrepreneurial (Tremblay, 3). The project-based path involves broadening skills into

other engineering disciplines through the assignment of an array of technical projects instead of specializing on a particular engineering sector. Engineers who endeavor to start their own companies may elect the entrepreneurial path. Finally, the hybrid path involves moving between the other paths without adopting a single career path. Although these three alternate career paths are options for engineers, most studies recognize the managerial and technical tracks as the primary tracks to the upper echelons of leadership (Biddle, 82).

IT Professional Career Path

Lee and Wingreen provide insight into information technology professional career paths and use KSAs to illustrate the differences in each successive role (Programmer/Analyst-Systems Analyst-IT manager). By examining Fortune 500 job ads, Lee and Wingreen were able to identify important KSAs for each phase of the IT professionals' career path. They also theorized that behavioral KSAs grow in importance and technical KSAs decline as the IT Professional progresses through the career path. Their research supports this premise as they identified a higher frequency of management KSAs (general knowledge of management, organization, project management, leadership, planning, and monitor and control) and social KSAs (interpersonal, and communication) with IT manager positions (Lee, 34).

Lee and Wingreen pointed to another study by Rosenberg that found that 54% of IT professionals desire a progression into management and only 15% wish to remain in the IT function for the duration of their careers (Lee, 41).

Transition to Management

Biddle and Roberts have studied the career transitions of 4,179 scientists and engineers from technical to managerial roles. Their research found that 1,374 (33%) of private sector engineers and scientists progress into management roles at some point in their entire careers and of those, 538 (39%) return to the technical track later in their careers (Biddle, 90). They also state that "managers will come from among those with the highest earning on the technical track" (Biddle, 86). In a follow up study into the six year promotion patterns of 333 scientists and engineers, Roberts and Biddle found that over three-quarters of participants will achieve senior level individual contributor roles within six years (Roberts, 569-570). Advancement beyond this level becomes significantly more challenging and less frequent requiring entry into lower-level supervisory positions.

Chief Executive Occupation Required KSAs

The United States Department of Labor maintains a detailed occupational survey called O*NET. There are 965 defined occupations[4] in the O*NET taxonomy. O*NET has been continually updated since 2001 by surveying three sources; job incumbents, occupational experts, and occupational analysts[5]. This thesis primarily focuses on three of these occupations; Chief Executives, Engineering Managers, and Computer and Information System Managers. O*NET defines these three occupations as:

1. **Chief Executives** determine and formulate policies and provide the overall direction of companies or private and public sector organizations within the guidelines set up by a board of directors or similar governing body. [They]

[4] http://www.onetcenter.org/taxonomy/2009/data_coll.html
[5] http://www.onetcenter.org/questions/10.html

plan, direct, or coordinate operational activities at the highest level of management with the help of subordinate executives and staff managers.

Reported job titles: Chief Executive Officer (CEO), President, Chief Financial Officer (CFO), Vice President, Chief Operating Officer (COO), Executive Director, Executive Vice President (EVP), Finance Vice President, General Manager, and Operations Vice President.

National Employment Trends:
Median wages (2008) $76.23 hourly, $158,560 annual
Employment (2006) 402,000 employees
Projected growth (2006-2016) little or no change (-2% to 2%)
Projected need (2006-2016) 118,000 additional employees

2. **Engineering Managers** plan, direct, or coordinate activities in such fields as architecture and engineering or research and development in these fields.

   Reported job titles: Engineering Manager, Project Engineer, Project Engineering Manager, Project Manager, Director of Engineering, Chief Engineer, Civil Engineering Manager, Principal Engineer, Process Engineering Manager, and Supervisory Civil Engineer.

   National Employment Trends:
   Median wages (2008) $55.42 hourly, $115,270 annual
   Employment (2006) 187,000 employees
   Projected growth (2006-2016) average (7% to 13%)
   Projected need (2006-2016) 51,000 additional employees

3. **Computer and Information Systems Managers** plan, direct, or coordinate activities in such fields as electronic data processing, information systems, systems analysis, and computer programming.

   Reported job titles: Information Technology Manager (IT Manager), Information Technology Director (IT Director), Information Systems Director (IS Director), Data Processing Manager, MIS Director (Management Information Systems Director), Information Systems Manager (IS Manager), Information Systems Supervisor (IS Supervisor), Computing Services Director, Director of Application Development, and Technical Services Manager.

   National Employment Trends:
   Median wages (2008) $53.95 hourly, $112,210 annual
   Employment (2006) 264,000 employees

Projected growth (2006-2016) faster than average (14% to 20%)
Projected need (2006-2016) 86,000 additional employees

Critical KSA Comparison

Critical Knowledge, Skills, and Abilities (KSA) for chief executives were gathered from the Occupation & Skill Computer-Assisted Researcher (OSCAR)[6] from the Texas Workforce Commission. OSCAR is a web based data analysis tool that uses O*Net data. The following chart shows the type of information that can be gathered via OSCAR/O*NET. It displays the critical KSAs for Chief Executives and compares them to Engineering Managers, and finally staff level Engineers (in this case Electrical Engineers).

Table 2.7: Critical KSAs – Engineering Track

Critical KSAs for Chief Executives	Electrical Engineers	Engineering Managers	Chief Executives
Business & Management Knowledge	75	96	100
Social Skills	40	96	96
Auditory & Speech Abilities	50	83	92
System Skills	80	79	92
Resource Management Skills	40	79	88
Arts & Humanities Knowledge	55	71	88

The color coding in these tables is as follows; Green – Extremely Important KSA for that occupation, Yellow – Very Important, Red – Important. OSCAR defines the critical/extremely important KSAs for Chief Executives as follows:

Business and Management Knowledge - Job requires knowledge of principles and facts related to business administration and accounting, human and material

[6]http://www.ioscar.org/tx/oscar.asp.

resource management in organizations, sales and marketing, economics, and office information and organizing systems.

Social Skills – Job requires the ability and willingness to work with people to achieve goals.

Auditory & Speech Abilities – Job requires abilities related to [listening] and speaking.

System Skills – Job requires the ability to understand, monitor, and improve socio-technical systems.

Resource Management Skills – Job requires the ability to allocate time, financial, material, and human resources efficiently.

Arts & Humanities Knowledge – Job requires knowledge related to the branches of learning concerned with human thought, language, and the arts.

This comparison shows fairly good alignment between the Engineering Manager and Chief Executive occupations with the areas of arts and humanities knowledge, system skills, auditory and speech abilities, and resource management skills being slightly less important for Engineering Managers than Chief Executives.

The table below shows the Chief Executive critical KSA alignment with Information Technology professions. The first category displayed is a staff level Computer System Engineer, or Architect role, followed by the Information System Manager, and finally the Chief Executive. Comparing the two career paths, the Information Technology related occupations start off with a stronger alignment with needed Chief Executives KSAs as compared to staff engineers, but Information System Managers do not develop the needed Chief Executives KSAs as effectively as

Engineering Managers. The primary purpose of this example is to show that different paths to chief executive positions could require different developmental approaches.

Table 2.8: Critical KSAs – IT Professional Track

Critical KSAs for Chief Executives	System Eng./Arch.	Information System Mgr.	Chief Executives
Business & Management Knowledge	58	100	100
Social Skills	54	79	96
Auditory & Speech Abilities	79	75	92
System Skills	71	75	92
Resource Management Skills	63	71	88
Arts & Humanities Knowledge	67	71	88

PERSONALITY CHARACTERISTICS

The third and final central theme, personality characteristics, relates to indentifying the personality styles and traits of executives and their alignment to organizational cultures. The key premise here is that having the right functional background and following the best engineered career path in a compatible industry are not sufficient if incompatibilities exist between personality characteristics and organizational culture.

Effects of Personality Styles on Leadership

One concept that has been written about frequently is the importance of the personality styles of leaders. Popular belief is that good executive leadership requires someone who has a gregarious personality. However, in his research, Jim Collins warns that "leaders whose main contribution was a charismatic style were actually negatively correlated with corporate success" (Menkes, 175). Collins concluded that the best leaders

he studied were often quiet and reserved. The key to success appears to be related to the individual's ability to overcome their introverted personalities and build meaningful human connections. As stated by Kahnweiler, "introverted people inevitably hit a wall in their careers when they don't attend to the relationships side of the equation" (Kahnweiler, 12).

As noted in the analysis of the OSCAR KSA data, social skills are extremely important for CEOs and Engineering Managers but only important for Electrical Engineers or Computer System Engineers. One rung on that missing ladder appears to be the development of interpersonal skills which allow the leader to achieve results by working with and through others. These books suggest that extroverted people have an early advantage because of their ability to quickly form relationships, but introverted people could have skill sets that enable them to be better leaders if they can get past the relationship barrier.

Five-factor model of personality

One of the most popular constructs for organizing personality traits is the Five-factor model. Cable and Judge summarize each factor as follows:

1. Extroversion – represents the tendency to be sociable, assertive, and active
2. Agreeableness – represents the tendency to be likable, nurturing, adaptable, and cooperative
3. Conscientiousness – refers to the traits of achievement, organization, task-focus, and dependability

4. Emotional stability – is the tendency to be secure, emotionally adjusted and calm

5. Openness to experience – which is the disposition to be imaginative, artistic, non-conforming, and autonomous (Cable, 198).

Rubin was able to confirm that the "agreeableness" predictor was strongly linked to transformational leadership behavior. Rubin was also able to downplay the role of extroversion as a predictive quality (Rubin, 835). His results showed "leaders high in extroversion and low in emotion recognition ability may be at a greater disadvantage than those low in extroversion but high in emotion recognition ability" (Rubin, 853). However Rubin concluded that the combination of high extroversion, high emotion recognition, and the ability to articulate a strong vision were the key determinates in predicting transformational leadership behavior.

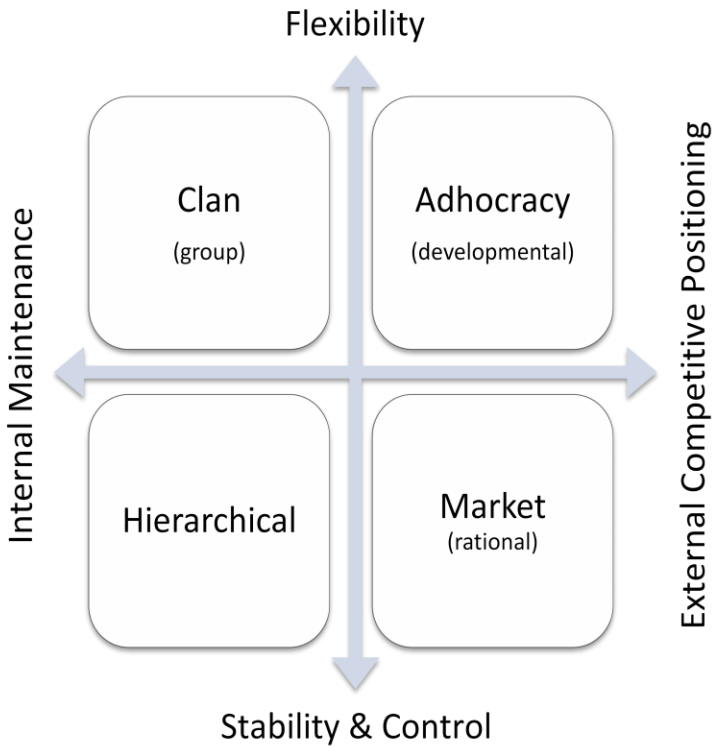
CEO Personality and Organizational Culture

In a recent study, Giberson, Resick, et al. examined the linkages between CEO personality and organizational cultures (Giberson, 124). Their study used the five-factor model personality test and Quin and Kimberly's competing values model (CVM) for assessing organizational culture which was subsequently expanded by Cameron (Giberson, 124). Giberson and Resick describe this model as follows:

> The CVM for culture posits that organizations experience competing tensions along two dimensions: the demands for flexibility versus stability and control, and a focus on internal maintenance versus external competitive positioning. These two dimensions combine to create four sets of values associated with one of four types of organization culture, specifically Clan, Adhocracy, Hierarchy, and Market cultures (Gilberson, 124).

The following diagram maps these four organizational culture types into the CVM. Giberson and Resick also provided commonly used alternate names for three of these cultures which are noted in parenthesis within the matrix (Gilberson, 124).

Figure 2.2: Competing Value Model Matrix



Giberson and Resick gathered information from 32 CEOs and 467 of their employees and found that CEOs with high agreeable scores were strongly associated with Clan cultures and low agreeableness (i.e., competitive) scoring CEOs were linked to Adhocracy cultures. In addition, high emotional stability scoring CEOs were linked to Clan cultures and the lower scores were tied to both the Adhocracy and Market cultures (Giberson, 133). The final relationship between CEO traits and organizational culture types linked low scoring openness CEOs to hierarchical based organizations. The

Giberson and Resick study found no relationship with the last 2 components of the five factor model, extroversion and conscientiousness (Giberson, 134).

Chapter 3: Study Methodology

The study of executives is a well researched area. The Spencer Stuart report is an excellent example. However, these studies lack specific details about executives with technical backgrounds. The goal of this thesis is to identify what career paths, advanced degrees, and supportive industries best enable engineers and other highly technical professionals to move past middle management layers into executive leadership. In order to support this thesis the following research methods were employed.

Identification of Top Company CEOs

The investigation began with a query from Dunn & Bradstreet's (D&B) North American Million Dollar database[7]. This data source provides organization and CEO names, birth years (very limited), total annual revenues, total employees, company location, Standard Industrial Classification (SIC) Codes, and a short biography, but unfortunately lacks any educational background information. The data was refined to exclude Canadian and Mexican firms, private companies, and corporations under $1Billion in revenue. These parameters were used to identify large publicly traded U.S. firm CEOs who would likely have biographical information publically available. These initial filters lead to the identification of 893 executives. The number was further reduced to 859 by eliminating duplicates due to some CEOs leading multiple subsidiaries.

[7] http://mddi.dnb.com/mddi/

Resolution of Standard Industry Classification Codes

Information from the United States Security and Exchange Commission (SEC) was gathered to decode the four digit SIC code provided in the D&B Million Dollar database. This allowed for the identification of the major industry group the organization belongs to and what specific segment within that industry with which they indentify.

Identification of CEO Educational Backgrounds

A spreadsheet was created from the D&B information and a research exercise was conducted to gather background education information and augment any missing, invalid, or incomplete data from the D&B Million Dollar database. Data was acquired from a number of sources including the following internet information aggregators; the Notable Names Database[8] developed by Soylent Communications, the web crawler/aggregator Zoom Information Inc[9], Bloomberg Businessweek executive profile search[10], Corporate Affiliations through LexisNexis Academic[11], and finally individual company websites.

The required information was generally accessible for the first 40-45% of the target research group. The data gathering activities were continued for each member of the data set using the Notable Names Database and Zoominfo information sources, but a decision was made to focus on only the top 500 executives due the difficulty in finding the needed information for the last 55-60% of the executives. Research activities with

[8] http://nndb.com
[9] http://zoominfo.com
[10] http://investing.businessweek.com/
[11] http://lexisnexis.com

sources such as Businessweek, LexisNexis, and company websites continued until all available data was collected for those 500 executives.

To deal with variances in degree naming, each post secondary degree gathered was classified as being technical or non-technical. For example, a Bachelor of Science degree in Business Administration was classified as a non-technical degree and a Bachelors of Arts in Biology was considered a technical degree. Finance and Economic majors were classified non-technical regardless of the degree type. Specific information about the major was only retained for technical degrees after this classification was made. An executive was classified as having a technical educational background if any degree level (i.e., undergraduate, graduate, or PhD) was classified as a technology major. Data was also collected regarding MBA and JD degrees so that the data set could be compared to the Spencer Stuart results. Honorary degrees were eliminated from the data collection.

Augmentation of Biographical Information

The initial D&B data source contained 65 records (7.6%) without biographical information. Reducing the sample to 500 CEOs eliminated a large portion of these omissions. Also, since this research is focused on CEOs with technical degrees, only 5 CEOs of the 151 with technical education backgrounds were missing biographical information and the research effort required was further reduced. However, a large number of the biographical data provided by D&B lacked the detail needed for this research. In these cases, subsequent sources from Businessweek, the Notable Names Database, and LexisNexis were used.

Identification of Technical Career Tracks

Once the biographical information was gathered for each of the 151 CEOs with technical backgrounds, the data was analyzed and each position held prior to being named CEO was classified into one of 15 functional groups. These classifications were also made in reverse chronological order so that information on career progression would be retained. Sequential lateral moves within a functional classification, such as a move from President of one subsidiary to another, were coded as a single entry. However, redundant moves between alternating functional groups, such as Administration to Operations and back to Administration were captured. The following table lists the functional groups that were used and provides a few examples of job titles that were encountered during the classification.

Table 3.1: CEO Functional Role Classification – Executive Level

Functional Classification	Example Roles
Consulting	VP of strategy consulting, Staff consultant, Management consultant
Customer Service	VP Customer Service, SVP Customer Service
Engineering	VP of Chemical Engineering, SVP Airplane Development, EVP Oilfield Services
Finance/ Accounting	Chief Financial Officer, VP of Finance, Comptroller
General Management/ Administration	President, General Manager, Managing Director
Human Resources	President of Employee Benefits, Director of Corporate Development, VP Personnel and Labor Relations
Information Management/ Technology	Chief Information Officer, EVP Information systems, Chief Technology Officer
Legal	General Council, Lawyer, Auditor
Marketing	Chief Marketing Officer, VP Worldwide Marketing, Director of Brand Management
Medical	M.D., SVP of Pharmacy, Surgeon
Operations/ Production/ Manufacturing	Chief Operating Officer, EVP Refining and Commercial Operations, SVP of Manufacturing
Research & Development	VP Pharmaceutical Product Development, Research Scientist, Director for Science & Technology
Sales/ Business Development	VP Sales, EVP & General Merchandise Manager, EVP Global Sales
Strategic Planning	SVP Corporate Planning, VP of Strategy
Supply Chain/ Logistics/ Shared Services	SVP Logistics, VP of Distribution, SVP Corporate Strategic Services

In addition to these assignments, the year the CEO took office was captured and a notation was made if the person spent part of their executive career track at another organization. The next chapter will detail the analysis and results generated from this data collection effort.

Chapter 4: Results

Identification of Technology Friendly Industries

Although this study was focused on CEOs with technical educational backgrounds (tech CEOs), it is useful when possible to compare the target with the sample as a whole. The first analysis case indentifies which industries have a positive proportion of tech CEOs (i.e., tech friendly industries). That is, if tech CEOs share the same distribution as the entire sample then one would expect approximately 30% (151/500) of the CEOs in each major industry classification to be tech CEOs. Naturally, this is not the case, but using this threshold we can identify industries that can be considered tech CEO friendly. The following table illustrates the top 10 major industries which have a higher than 35% portion of tech CEOs and a minimum of 5 tech CEOs assigned. The calculated "Percent" column is generated by taking the number of tech CEOs in the Industry group and dividing by the total number of CEOs assigned. This list of ten major industries employs 63.6% of the tech CEOs in our study (96/151).

Table 4.1: Top Ten Industries for Tech CEOs

Major Industry	500	Tech	Percent
1. Engineering & Management Services	13	9	69%
2. Instruments & Related Products	16	11	69%
3. Transportation Equipment	20	11	55%
4. Electric, Gas & Sanitary Services	29	15	52%
5. Chemicals & Allied Products	25	12	48%
6. Paper & Allied Products	11	5	45%
7. Industrial Machinery & Equipment	29	12	41%
8. Business Services	22	9	41%
9. Miscellaneous Retail	14	5	36%
10. Electronic & Other Electric Industries	20	7	35%

Conversely, the following table details ten major industries where tech CEOs are underrepresented. To be included in this table the major industry must have at least one tech CEO and at least 5 CEOs assigned to it.

Table 4.2: Bottom Ten Industries for Tech CEOs

Major Industry	500	Tech	Percent
1. Food Stores	15	1	7
2. Depository Institutions	24	2	8
3. Food & Kindred Products	21	2	9
4. Wholesale Trade - Nondurable Goods	10	1	10
5. Insurance Carriers	36	5	14
6. General Merchandise Stores	14	2	14
7. Apparel & Accessory Stores	6	1	17
8. Automotive Dealers & Service Stations	10	2	20
9. Fabricated Metal Products	5	1	20
10. Health Service	17	4	23

There were 22 major industries in the sample that did not have any tech CEOs. These industries include:

- Transport by Air
- Printing & Publishing
- Hotels & Other Lodging Places
- Apparel & Other Textile Products
- Eating & Drinking Places
- Furniture & Home Furnishing Stores

The data confirms logical expectations that tech CEOs are highly represented in industries with a high manufacturing focus and have lower representation in financial, retail and food service industries.

Baseline Comparison to Previous Studies

In order to show the validity of this approach the following tables show directly comparable results between this study and the 2008 Spencer Stuart report. The numbers in parentheses represent the number of occurrences of the particular CEO graduate degree found during this study. The "Results" column represents the division of the number of occurrences found in this study by the total sample size of 500.

Table 4.3: Study Comparison of CEO Graduate Degrees

500 CEOs Graduate Degrees	Spencer Stuart	Results
M.B.A. (187)	39%	37.4%
Other Masters Degree (82)	14%	16.4%
Law Degree (54)	10%	10.8%
PhD (24)	4%	4.8%

The table above shows fairly good alignment between the two studies given that over two years have occurred since the Spencer Stuart data was gathered and published. The main difference between the two is the Spencer Stuart study collected approximately six more M.B.A. and ten fewer other Masters degrees than this study. In reviewing past Spencer Stuart studies, variations between reporting years were much more significant than the differences shown in this study. Turnover in CEO membership is likely a factor in explaining the differences. In fact, a number of CEO changes were discovered when comparing research information gathered against the latest D&B information that was the basis of this study.

Identification of CEO Educational Backgrounds

As mentioned before, one of the major focus items of this study was to identify tech CEOs from the sample as a whole. Previous studies have not provided this information, thus requiring significant effort to collect the data. The following series of tables breaks down the number of undergraduate and graduate degrees with technical majors identified during this research. The title area denotes the sample size, and the actual occurrences discovered are detailed in parentheses. The results column represents a simple division of number of occurrences by the sample size.

Table 4.4: Breakdown of Technical/ Non-Technical CEOs

CEOs (n=500)	Results
With Non-Technology Education (307)	61.4%
With Technology Education (151)	30.2%
Unknown (24)	4.8%
No College Degree (18)	3.6%

It is important to note that the above table does not confer the total number of degrees awarded. Instead a review of each degree was made to determine if at least one of them was technical in nature. A CEO was given the designation as a CEO with a technology background if the degree major was deemed technical. This is not to suggest that the other CEOs are without technical capabilities, only those designated as tech CEOs made significant investments into developing technical skills during their university studies.

Gathering degree majors was particularly challenging for undergraduate degrees. Many in the executive profiles would simply list BS or BA for these degrees while detailing graduate degrees at great length. Extensive searching was required to develop these results but for 4.8% of the CEOs in the sample, no education information could be obtained (representing 24 CEOs). Finally it is important to note that eighteen CEOs in the study did not attempt or were not awarded any post-secondary degrees. Even though this includes technology powerhouses like Michael Dell of Dell Inc., Steven Jobs of Apple Inc, and Larry Ellison of Oracle Corporation, for the purposes of this study, these individuals were not designated as tech CEOs.

Further Study into CEO Advanced Degrees

In addition to the work above, analysis was conducted on the types of advanced degrees America's top public CEOs have obtained. The next two tables denote the specific post graduate degree combinations that were discovered. As with the tables above, the title area denotes the sample size and the actual occurrences discovered are detailed in parentheses. The results column represents a simple division of number of occurrences by the sample size.

Table 4.5: Breakdown of CEO Advanced Degrees (Entire Sample)

500 CEOs Advanced Degrees (n=300)	Results
Masters only - non-MBA (49)	16.3%
MBA only (161)	53.7%
Masters & MBA (12)	4.0%
J.D. only (41)	13.7%
J.D. & Masters (3)	1.0%
J.D. & MBA (10)	3.3%
PhD only (9)	3.0%
Masters & PhD (11)	3.7%
MBA & PhD (1)	0.3%
Masters, MBA, & PhD (3)	1.0%

Note that only 300 of the 500 CEOs in this study have advanced degrees and that numbers in parentheses represent CEOs with that post graduate degree combination and not the total number of degrees of that type. This table also treats multiple degrees of the same type, for example multiple Masters Degrees as a single occurrence. The MBA is the most prevalent advanced degree choice among the larger study sample followed by the non-MBA Masters and the Law degree. This data also suggests that getting additional

advanced degrees has little cumulative benefit as a predictor of executive ascension. The same analysis was continued on the tech CEOs sample as well and is summarized below.

Table 4.6: Breakdown of CEO Advanced Degrees (Tech CEOs only)

151 Tech CEOs Advanced Degrees (n=101)	Results
Masters only - non-MBA (26)	25.7%
MBA only (45)	44.5%
Masters & MBA (7)	6.9%
J.D. only (3)	3.0%
J.D. & Masters (2)	2.0%
J.D. & MBA (1)	1.0%
PhD only (5)	5.0%
Masters & PhD (8)	7.9%
MBA & PhD (1)	1.0%
Masters, MBA, & PhD (3)	3.0%

In comparing the tech CEOs results with the sample size as a whole you can see a sharp downgrade (9.2 percentage points) in the frequency of the MBA degree with a similar sized increase in non-MBA Masters degrees (9.4 percentage points). Since 44.5% of tech CEOs have them, the MBA is still the most obtained graduate credential. Another interesting difference between the two groups is the sharp reduction in law degrees (10.7 percentage points) and some modest increases in PhD degree combinations within the tech CEO's group.

Identification of Technical Degree Types

Analysis of the degree majors for each of the tech CEOs is summarized in the table below. The degrees types were normalized to account for minor differences in naming conventions. The top degree type, "Engineering – unspecified", represents

degrees where no specific area of engineering study was available. A review of the table below shows that the engineering disciplines are the dominant degree type for technical CEOs. In fact, engineering related degrees represented 64.9% of the tech CEO group and 19.6% of the total sample (n=500) which is slightly less than the 22% reported by the 2008 Spencer Stuart study. In addition, there were 15 other technology degree types identified during this effort totaling 35 individual degrees. Degree types were obtained for all 151 tech CEOs. Degree types are primarily from undergraduate technology degrees. Graduate level technology degree types were recorded only when undergraduate degrees were not classified as technical. By using this method each of the 151 tech CEOs was assigned only one technology degree major.

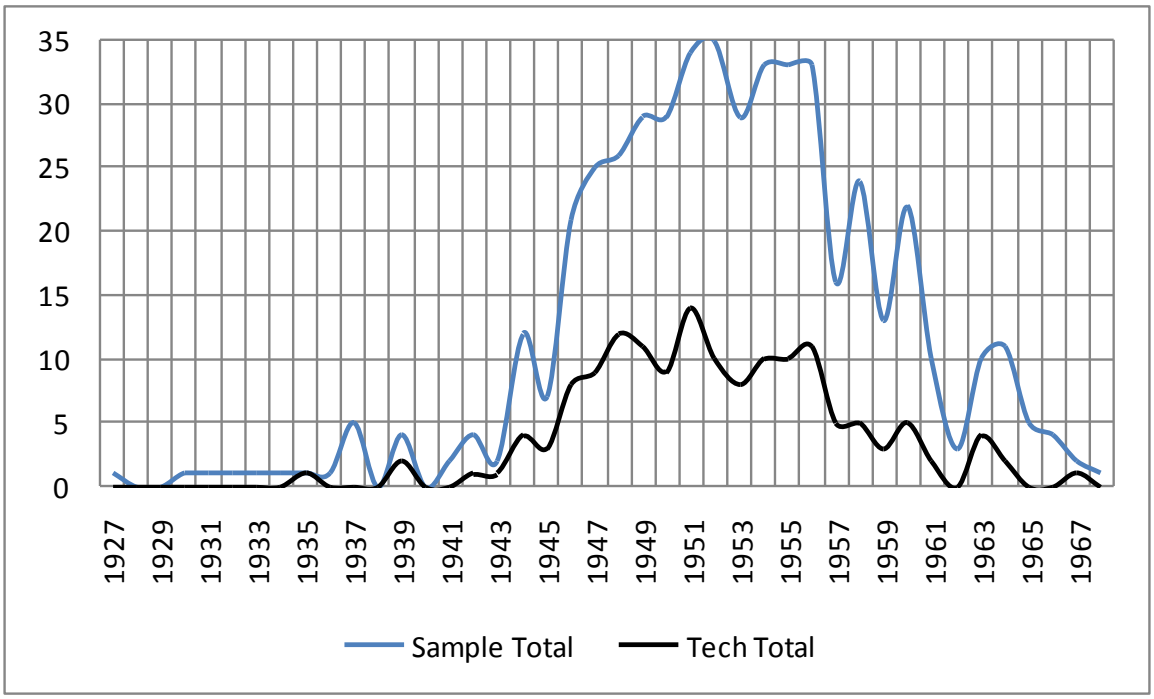
Table 4.7: CEO Top Technical Degree Majors

Top 10 Tech Majors	Occurrences
1. Engineering – unspecified	28
2. Electrical Engineering	20
3. Mechanical Engineering	14
4. Industrial Engineering	13
5. Computer & Information Technology	10
6. Mathematics	10
7. Biology	9
8. Civil Engineering	9
9. Chemistry	7
10. Chemical Engineering	6

Tech CEO Demographics

Birth year information was not available for eight CEOs in the entire sample but that data was obtained for every tech CEO. The following graphs show the birth year distribution for 492 CEOs against the birth years of the 151 tech CEOs. The tech CEOs group was slightly older than the CEO sample at large with the mean age of the tech CEO being 58 years and the whole CEO sample being 57 years on average. The distribution of the curve shows good alignment and a conclusion can be drawn that age is not a distinguishing factor between tech CEOs and top CEOs in general.

Figure 4.1: CEO Birth Years by Occurrences



Although information on CEO gender was not collected for the whole sample it was collected for the tech CEOs. Only 6 (4.0%) of the tech CEOs in this study are female. Although these numbers are low they are slightly better than the figures provided in the Spencer Stuart study where only 14 of the top 500 (2.8%) CEOs were identified as being female. However, the statistical difference is less than two individuals so no conclusions can be drawn about any gender advantages for female tech CEOs other than it is equally difficult for females, regardless of educational background, to obtain the CEO role in these large companies. The following table illustrates the six female tech CEOs in the study ordered by annual revenues.

Table 4.8: Female Tech CEOs

Tech CEO	Organization	Degree Major
Lynn Elsenhans	Sunoco	Mathematics
Ellen Kullman	Du Pont	Mechanical Engineering
Ursula Burns	Xerox	Mechanical Engineering
Linda Hudson	Bae Systems	Systems Engineering
Carol Bartz	Yahoo	Computer Science
Stephanie Burns	Dow Corning	Chemistry

The Influence of Insider vs. Outsider tech CEOs

In conducting research into functional areas of tech CEOs it was discovered that 66 (43.7%) had executive level roles with previous employers. For the purposes of this study a tech CEO was considered an "outsider" when this situation occurred. Nearly all the executive bios obtained in this study outlined executive careers only, leaving out positions held as individual contributors or mid-level managers. Therefore it is important to note that an "insider" in this study does not have to spend his/her whole career at the organization, just the executive ranks. This data gathering was also hampered by coding decisions dealing with company acquisitions. In general, executives of acquired companies were coded as outsiders.

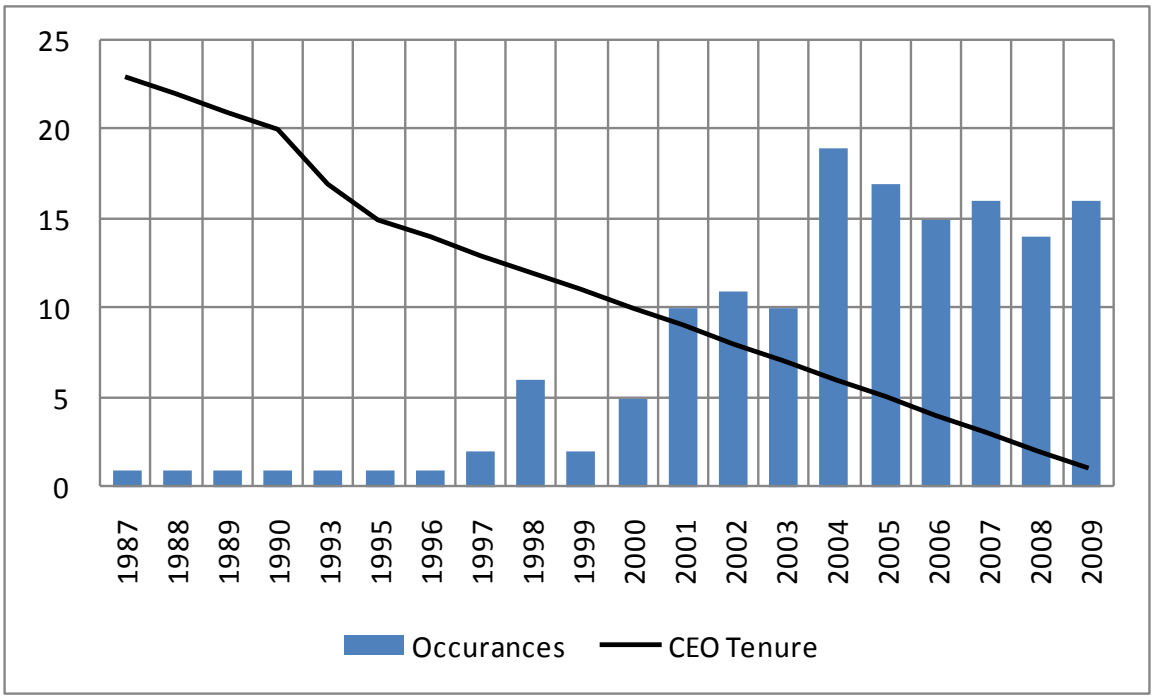
Unfortunately there is no data for the non-tech CEOs to compare these results against. The Spencer Stuart study did identify that 19% of CEOs in their study remained at the same company their entire careers but that information does not align with the executive level only approach that was taken in this research.

Tech CEO Tenure

The Spencer Stuart study reported the average CEO tenure as 6 years and the median tenure as 4 years for its top 500 CEOs. During this study, the average tech CEO tenure was found to be 6.2 years and median tenure was 5.0 years. For cosmetic reasons, the CEO of WiPro was removed from the graph below as he started his company as a sole proprietorship in 1968. However, this data was included in the tenure calculations above. Aside from a slight variance in median tenure, there is good alignment between the tech CEOs in this study and the tenure results from 500 CEOs from the Spencer Stuart study.

The graph below shows the number of occurrences of CEO appointment by year represented by the bar series against the number of tenure years shown in the line series. Tenure years were calculated by subtracting the appointment year shown in the horizontal axis from the current year, 2010.

Figure 4.2: Tech CEO Tenure vs. Appointment Year Occurrences



Tech CEO Position Analysis

The final part of analysis in this study related to the career path the tech CEOs took to the top. The table below groups CEO previous functional roles in reverse chronological order meaning that Role 1 signifies the role served just prior to their appointment as CEO. The information gathered contained, in one extreme case, seven previous functional roles. However for simplicity's sake, Roles 4 through 7 were tallied into a single column of this table. Also, as pointed out earlier, lateral moves within the same functional area were considered a single occurrence, but alternating moves, such as from General Management, to Operations, and back to General Management were collected. Functional roles for each of the 151 tech CEOs were captured for the role just

prior to appointment as CEO, but the availability of past role information drops rapidly as shown in the last row of the table below.

Table 4.9: Tech CEO Career Paths

Functional Area	Role 1	Role 2	Role 3	Role 4-7	Total
General Management/ Administration	82	37	31	18	**168**
Operations/ Manufacturing/ Production	55	39	10	10	**114**
Engineering	3	13	12	7	**35**
Sales/ Business Development	4	6	3	5	**18**
Marketing		8	3	6	**17**
Finance/ Accounting	3	6	5	2	**16**
Information Management/ Technology	1	5	2	3	**11**
Strategic Planning	1	1	4	4	**10**
Supply Chain/ Logistics		2	2	1	**5**
Medical		4		1	**5**
Consulting	1			3	**4**
Legal		1	3		**4**
Human Resources	1		1	2	**4**
Research & Development		1	2	1	**4**
Customer Service			2		**2**
Total	**151**	**123**	**80**	**63**	**417**

Although there are likely some variations in the assignment process, comparing the Spencer Stuart results for role assignments just prior to CEO appointment shows some interesting differences.

Table 4.10: Study Comparison of CEO Just Prior Roles

Function Role Just Prior	500 CEOs[12]	Tech CEOs
Operations	31%	36.4%
Finance	21%	2.0%
Marketing	12%	0.0%
General Management	6%	54.3%

Although there is fairly good alignment in operations percentages there are significant differences for the finance, marketing and general management roles. In this study more than half of the tech CEOs ascended to CEO from General Management/ Administration positions. It was observed that frequently the tech CEOs had a title of president of a subsidiary company or major division just prior to appointment as CEO. This does not appear to be the case with the Spencer Stuart data. Second behind General Management roles was Operations for the tech CEOs with Chief Operating Officer as one of the most common titles. The finance and marketing roles which were prevalent in the Spencer Stuart study were not as significant for tech CEOs career paths.

Finally the tech CEO role information gathered in this study was grouped into output functions and throughput functions according to the Hambrick and Mason career path profile. Three roles did not fit into these definitions and were grouped into "other functions" category. The following table details the classifications that were made and shows a preference for throughput functions for the tech CEOs in this study.

[12] *500 CEOs percentages gathered from the 2008 Spencer Stuart study.*

Table 4.11: Tech CEOs by Functional Tracks

Functional Area	Total
Operations/ Manufacturing/ Production	114
Engineering	35
Finance/ Accounting	16
Information Management/ Technology	11
Supply Chain/ Logistics	5
Consulting	4
Research & Development	4
Customer Service	2
Throughput Functions Total	**191** (45.8%)
Sales/ Business Development	18
Marketing	17
Legal	4
Human Resources	4
Output Functions Total	**43** (10.3%)
General Management / Administration	168
Strategic Planning	10
Medical	5
Other Functions Total	**183** (43.9%)

It was also interesting to learn how few of these CEOs actually served in engineering or research and development capacities at the executive levels, even though they were likely major portions of their early careers. Another piece of information which was anecdotally gathered during this study was the frequency in which these executives moved between these roles leading to CEO appointment. It appears that many of them went through a multi-year "grooming" process within the executive ranks with two years or less at each assignment. Also, the frequency of international assignments for these executives, as reported in the Spencer Stuart study, was noticeable.

Chapter 5: Conclusions

KEY TAKEWAYS

Technology friendly/unfriendly industries

This research identified a number of major industries that contain a disproportionate amount of tech CEOs. Further analysis shows that these technology friendly industries, meaning companies with much higher than average percentage of tech CEOs, are primarily involved in industrial age industries (i.e., manufacturing based) or provide services that support those industries. It should be noted that since this study was focused on the 500 largest companies in the United States in terms of revenue this same distribution may not apply to emerging information age organizations that have not exceeded the revenue thresholds used in this study.

Conversely, the financial, consumer retail and services industries were shown as environments with a disproportionally lower number of tech CEOs. In this case disproportionally lower means less than 25% occupancy of tech CEOs. These industries employ business majors nearly exclusively or at least at a higher percentage than the general sample population. This information should be helpful for new graduates with CEO career aspirations on which industries to target.

Important technical degrees

Comprising nearly 65% of the tech CEOs educational background, engineering is still the premier technical degree. Degrees in mathematics, the physical sciences, and computer and information science were also prevalent in this study. Given the importance

of the manufacturing industry as the foundation of the nation's economy, it is not surprising that educational backgrounds needed by the CEOs of the large companies in this study fall within the engineering realm. Application of these results to smaller and emerging information age organizations should be avoided until further research is conducted to support this premise outside the target group of this study.

Collection of other advanced degrees

It should be of no surprise to most that the achievement of higher education is becoming more of a prerequisite for the upper echelons of corporate management. In fact this study showed that less than 5% of the top 500 CEOs did not receive post secondary degrees. In addition, the emergence of the graduate level degree has become an increasingly important factor as well. In fact, sixty percent of the 500 CEOs in the study had graduate degree(s). There is little argument for the requirement of CEO candidates to have multiple graduate degrees as only 15.3% of CEOs with graduate degrees had more than one.

However, when information gathered on the tech CEOs is examined, a number of interesting differences appear. Although the MBA remains the most prevalent graduate degree awarded at 44.5% there is a downgrade of 9.2 percentage points in frequency of the MBA when compared to the sample as a whole. The balance of this downgrade is completely transferred to non-MBA Masters Degrees. Also there is an even larger reduction in Law degrees within the tech CEO ranks but a slight increase in the percentage of PhDs. Therefore even though the MBA is dominating in both groups;

executives with non-MBA Masters Degrees can be successful in reaching the CEO position. However, when considering a second advanced degree, the Masters plus PhD combination slightly outperforms the Masters plus MBA option.

Application of Career Path Profiles

The tech CEOs in this study were evaluated using the four components of Hambrick and Masons' career path profiles (CPP); functional tracks, insider/outsider status, formal education, and ages (Hambrick, 719). For the functional track component, this study showed overwhelmingly that tech CEOs excel in throughput functions and it is nearly a prerequisite to serve as the head of these functional groups in the later stages of CEO ascension. In fact this study found that only 10.8% of roles held by tech CEOs were in areas classified as output functions.

The second component is the insider/outsider status of the individual. The main focus of this component is to determine if the individual has had enough time to acquire firm-specific knowledge. Multiple definitions were discovered to determine outsider status including a requirement for a minimum of five years with the organization to be considered as an insider. There has also been some discussion of the role of industry specific knowledge as a substitute for the threshold of firm-specific knowledge. In this study a person was considered an outsider if a portion of their executive career was performed at another company even if it was an acquired company. This study found that tech CEOs had executive level roles with other employers during their career paths in 43.7% of the cases.

One conclusion can be made from these results: tech CEOs appear to have more latitude in accepting career paths outside their organization and can avoid obstacles by strategic switching of companies in order to get on a career path that aids their progression. This also seems to suggest that the industries that the tech CEOs operate in are not averse to hiring outside candidates for senior executive positions.

The third category is formal education which has already been covered above. Tech CEOs have educational backgrounds primarily in engineering related disciplines; many also have MBAs or other Masters degrees. The ones who have multiple graduate degrees favor a Masters plus MBA combination followed by the Masters plus PhD combination. One area of the CPP model that was not captured during this study was the prestige of the degree granting university. This limitation could be a factor that is significant in predicting CEO ascension. During the raw data capture it did not appear that this factor was as important for technical degrees as other studies have stated it is for non-technical degrees like the Ivy League Bachelors in Arts or the Harvard MBA.

The final component deals with age and a determinate for potential closeness to retirement age. The premise behind this model component is that the closer one is to retirement age the less likely they will be driving major changes to their areas of influence or their individual careers. This study did not find any significant differences in the age demographics between tech CEOs and the general CEO population. This study also did not find any material differences in CEO tenure as well.

Finally, although not specifically a part of the CPP model, this study did look at gender but found that the CEO role is still nearly exclusively male dominated in these large organizations and the ratio between tech and non-tech CEO gender were similar. The only conclusion that can be potentially made is that the tech CEO's route does not offer females any substantially different opportunities from their non-tech counterparts. But it should be noted that the sample size of tech CEO females was 4% and less than 3% in the Spencer Stuart study.

Identification of technical career tracks

The sequencing of the positions held by the tech CEOs was a key focus of this research. The data shows a rapid departure from the technical positions these CEOs likely held earlier in their careers. In fact only 8.4% of tech CEOs held engineering positions at the executive level. Those holding information technology executive positions fared even worse with only 2.6% of the positions held. Consulting and research and development executive positions were shared by less than one percent each. It is clear that once past the ranks of mid-management, these executives, for the large part, leave their technical careers behind.

During data collection two major pathways were apparent. First, 40.3% of the career positions were in the general management/ administration functional area. Typically these executives would lead major operating divisions for the companies. Titles included Group President of the Wireless Division, and General Manager of an international subsidiary. This was most often the final position before ascension to the

CEO level representing 54.3% of the tech CEOs in the study. This was a key finding about tech CEOs as it is in stark contrast to the 6% reported by the Spencer Stuart study which only looked at the CEO group as a whole.

The other major tech CEO career pathway involved the operations functional area where titles such as Chief Operating Officer (COO) and EVP of Manufacturing were prevalent. This functional area represented 27.3% of the tech CEO positions captured in the study and represented 36.4% of the roles held just prior to CEO appointment.

These two final steps in the career pathways were traveled by over 90% of the tech CEOs in this study compared to the Spencer Stuart study result of 37% for the entire CEO population. It is clear that hiring practices for tech CEOs favor the general management or operations route over more traditional business functions such as finance and marketing.

A couple of interesting observations were made during these analyses that were not expected. First, the frequency of executive moves during the final stages of these career progressions was surprising. These appointments often were very short, 6 to 18 months on average, and involved either moving between operations and general management or geographical differences as in working for various subsidiary companies. These actions had the appearance of a directed grooming process. Also the Spencer Stuart study discussed the growing importance of international assignments; however it was not clear until working with the data in this study that these assignments occur as executive appointments.

Identification of KSA's

In chapter 2 the application of the O*NET taxonomy of 965 occupations was discussed. The Texas Workforce commission's OSCAR web-based application was cited as a tool for comparing the critical Knowledge Skills, and Abilities (KSA) for two O*NET occupations. It was identified from this data that there are 6 extremely important KSAs for the Chief Executive occupation. Two separate career paths were illustrated as examples for identifying KSA gaps between career progression steps. The two example progression paths of an engineer and IT analyst demonstrated that different KSAs need to be developed at different career stages. This evaluation is important through all stages of the career path but is critical for developing the capabilities to cross the "gaps in the ladder" to the executive ranks.

Suggestions for Future Research

This research was limited by the publically available information and could not garner insight into the actual culture and structures of the organizations the tech CEOs lead. Also, information regarding specific leadership styles could not be gathered. The ideal method for capturing this information would be through direct interviews or surveys with the tech CEOs indentified in this study. Finally the transition roles between mid-management and the executive ranks were difficult to obtain, as CEO profiles typically only detail the executive positions held. Therefore, information on the transition periods was very limited. Future research that addresses these limitations could be used to improve the understanding of the career paths taken by these tech CEOs.

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Vita

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