IT Leaders: Who Are They and Where Do They Come From?

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ABSTRACT

In many firms, Information Technology (IT) leaders assume different titles, the most common ones being Chief Information Officer or Chief Technology Officer. These leaders are usually the highest ranked executives in-charge of the IT governance practices in their firms. The job designations held by these IT leaders have been in existence for the last three decades. The objective of this research is to investigate the hiring trends of IT leaders, as well as their educational backgrounds. Since the findings of this study have the potential to influence the education, training, and hiring of potential IT leaders, these results are beneficial to both educators and practitioners. This exploratory study uses objective firm level longitudinal data spanning a period of 11 years (1997-2007) that includes the pre and post Year 2000 (Y2K), the dot com boom and bust years, and other significant events which have influenced the overall US economy and the IT industry. Using 1299 instances of IT leader hires, the results show that many firms have a top management position in charge of IT. Many of these IT leaders have a technical undergraduate degree and a business graduate degree. The research also reveals that most of these IT leaders did not obtain either their undergraduate or graduate degrees from the top tier schools as classified by the *US World News and Report*, *BusinessWeek* or *Financial Times*.

Keywords:. Careers, Computing majors, Curriculum design & development, Employment, Job skills

1. INTRODUCTION

The field of Information Systems (IS) has grown phenomenally within the past several decades, and IS researchers have investigated various aspects relating to this growth. One of these research domains addresses the career paths of IS graduates and has yielded results that show that, upon graduation, IS (we hereafter use IS to refer to Management IS, Computer IS, Information Science & Systems, and Information Technology) graduates work in various industries as programmers, network engineers, database administrators, business/system analysts, and business/IT leaders. A number of studies have also sought and identified the required skills for IS graduates (Downey, McMurtrey, and Zeltmann, 2008; Lee and Mirchandani, 2010). Among the highest managerial IS-related positions to which these graduates can rise to is that of an IT leader (we hereafter use IT leader to refer to the top-most manager in the firm in-charge of IS and may be referred to as Chief Information Officer (CIO), Chief Technology Officer (CTO), Vice President (VP) of Information Services/Systems, and VP of IS among other titles).

A number of researchers have also explored various aspects related to the holders of this position. The various themes addressed include the IT leaders' tenure and reporting structure (Banker, Hu, Pavlou, and Luftman, 2011), the performance and turnover rates of IT leaders (Hunter, 2010), IT leaders' business knowledge (Armstrong and Sambamurthy, 1999), the values and qualities of effective IT leaders (Earl and Feeny, 1994), and IT leaders' background and experience (Applegate and Elam, 1992). A detailed listing of these and other past studies that explore various dimensions of IT leadership is shown in Table 8 in the appendix. The table also includes the variables and the sampling methods used in the corresponding studies.

Although IT leaders are the highest ranked firm executives overseeing the entire organization's Information Technology Governance (ITG) practices (Banker et al., 2011), their positions and roles are relatively new. In contrast, the roles and responsibilities of other top level

executives—such as Chief Executive Officers (CEOs), Chief Financial Officers (CFOs), Chief Operating Officers (COOs), and other members of the Top Management Team (TMT)—have existed for a longer period (Schubert, 2004). However, in the recent past, the creation of new IT leader positions has been on the rise (Chatterjee, Richardson, and Zmud, 2001; Khallaf and Skantz, 2011). Thus, the position of an IT leader has become more influential due to the multifaceted role of IT in organizations. For instance, IT creates business value by guaranteeing better IT service delivery through the alignment of IT and business strategies (Agarwal and Sambamurthy, 2002) as well as firm-driven IT innovation endeavors (Karanja and Bhatt, 2011).

The potential to create and sustain a firm's competitive advantage is premised on the organization's managerial IT skills (Mata, Fuerst, and Barney, 1995). Consequently, the roles played by IT in the overall internal and external organizational integration, coupled with government legislation—such as the Health Insurance Portability and Accountability Act (HIPAA) Privacy and Security Rules as well as the Sarbanes-Oxley (SOX) Act (Sarbanes and Oxley, 2002)—have resulted in the incorporation of IT leaders into many firms' organizational TMTs (Ranganathan and Jha, 2008; Preston, Chen, and Leidner, 2008). This inclusion of IT leaders in TMTs has been shown to enrich the IT leaders' business knowledge by offering them opportunities to access the latest information on business trends, thus enabling them to relate IT's role to the overall organizational strategy (Armstrong and Sambamurthy, 1999; Preston, Chen, and Leidner, 2008). Membership in the TMT also offers an IT leader a chance to establish rapport with other members of the TMT by acting as an IT consultant. Additionally, the presence of an IT leader in the TMT may also enhance other members' IT knowledge and create an appreciation of the role of IT in the organization. These constant interactions and closer collaborations between the IT leader and other TMT members may at times result in more funding and acceptance of IT projects (Bassellier, Benbasat, and Reich, 2003; Sambamurthy, Bharadwaj, and Grover, 2003).

In spite of the strategic role played by IT in organizational competitiveness (Banker et al., 2011; Karanja, Bhatt, and Ashraf, 2010) and the intricate nature of the IT leaders' roles, there are limited studies that offer a systemic view of the academic competencies and other characteristics of these IT leaders (Sojer, Schlager, and Locher, 2006). Furthermore, research on ITG, and specifically IT leadership as a whole, has received modest attention in the IS field (Karahanna and Watson, 2006). For the most part, many of the extant studies were conducted a few years ago, and their relevance to today's academic and business environment is debatable—mainly because IS is a dynamic field that continues to evolve rapidly through software and hardware developments as well as through innovations in communications and telecommunications technologies as exemplified by the emergence and growing importance of social networks and the enactment of new IT-oriented government legislation.

Additionally, many of the studies on IT leadership have been descriptive in nature and have provided only anecdotal subjective evidence. Subsequently, researchers have called for more rigorous theory-based empirical research which will ensure the advancement of knowledge on the domain of ITG and specifically on IT leadership. Instructively, Gu, Xue, and Ray (2008) argued in their study that firms differ in ITG alignment. Although their study did not address the causes of such variations, they suggested that it could be due to the knowledge and skills of the senior IT management personnel and called for further inquiry into this phenomenon.

The present study aims at addressing some of the limitations of the earlier research studies as well as to lay the groundwork for further investigation in this research domain. This study builds on and extends prior ITG studies that have investigated some aspects of IT leaders in a number of ways. As stated earlier, many of the previous studies have used subjective data collected from single key informants, (usually IT leaders) who, although knowledgeable about the ITG issues (Campbell, 1955), might not always provide consistent data (Foedermayr and Diamantopoulos, 2008; Seidler, 1974) especially in large organizations. To mitigate this shortcoming, this research utilizes objective panel data to study the hiring trends and educational backgrounds of the IT leaders.

Moreover, as mentioned earlier, many of the studies investigating the traits and roles of IT leaders are based on anecdotal evidence and practitioners' sources such as Gartner and Forrester Group, or individual profiles from *CIO*, *ComputerWorld (CW)*, and *InformationWeek* (IW) industry magazines. This study makes use of secondary objective data that is based on actual announcements that firms made when they hired IT leaders. The use of secondary objective data is a marked departure from studies that investigate the traits and credentials of IT leaders based on position advertisements that are placed in the mass media (Applegate and Elam 1992; Chun and Mooney, 2009). The study is also motivated by the need to develop IT leaders in the classroom by highlighting both the educational backgrounds and skills that students need as future top IT decision and policy makers.

In this paper, we argue that an understanding of the hiring trends and the educational backgrounds not only adds to the ITG literature, but also specifically extends the research on IT leaders with implications for both industry and academia, in a number of ways. First, by analyzing the attributes of these IT leaders, and given the multi-faceted nature of IS, we aim at determining whether firms hire or are inclined to hire IT leaders with multi-disciplinary skills such as IT, engineering, sciences, accounting, finance, management, business administration, law, security, and others. Secondly, by understanding the predominant educational backgrounds of IT leaders, educational institutions and IS departments would recognize and have a better appreciation of the educational credentials needed for a successful career in executive level IS positions. Eventually, IS educators would also seek to incorporate and re-emphasize in the IS curricula the content that inculcates knowledge and skills that future IT leaders need.

The time period covered in the study is 1997-2007. It includes the pre and post Year 2000 (Y2K), the dot com boom and bust years, as well as the implementation of the HIPAA Privacy and Security Rules, and the SOX Act legislation which were periods that saw significant changes in the US economy in general, and particularly in the IT

industry. In summary, the research seeks answers to the following questions:

- What are the hiring trends of the IT leaders?
- What are the dominant undergraduate degrees among the hired IT leaders?
- What are the most popular graduate degrees with these IT leaders?
- Where did these IT leaders acquire their degrees?

The rest of the paper is organized as follows. The following section, Section 2, presents a brief background literature on ITG practices; this section also addresses the issue of the education credentials of the IT leaders and identifies contingency factors from the extant literature. Section 3 provides a detailed analysis of the research method and a detailed description of the data collection strategy. Section 4 provides an in-depth analysis of the IT leaders' attributes, as well as a detailed assessment of the hiring trends and the education backgrounds of these IT leaders. Finally, Section 5 presents a detailed discussion on the practical implications of this research; this section also includes the limitations of the current research, and concludes with suggestions for future research avenues.

2. BACKGROUND

Effective IT leaders should exhibit superior managerial skills, demonstrate leadership skills, and be good communicators (Baltzan and Phillips, 2009). Additionally, these leaders should be skilled at strategic thinking and planning, and should have a good grasp of business operations and processes. The aforementioned traits are either learned or acquired through experience. The following section demonstrates that, although a plethora of research studies exist that investigate the various aspects of IT leaders, there is limited research which specifically addresses how the various characteristics and skills of these IT leaders are acquired or from where these skills are attained. This kind of information would serve both students and schools/programs that aspire to prepare leading IS professionals.

2.1 Studies of IT Leaders

IS emerged as a distinct academic discipline in the 1950s and was integrated in the business school curricula in the 1960s; however, as shown in Table 1, the official IS curriculum was not published until the late 1970s. The proliferation of IS resources within firms was heralded by the emergence of the ARPANET, which later become the Internet, and the introduction of the PC by IBM in the late 1970s. The resultant adoption of these IS resources called for planning, coordination, and management in order to create IT driven business value. Initially, IT leaders were referred to as Functional IT heads, IS managers, or Electronic Data Processing (EDP) managers (Nolan, 1976; Ives and Olson, 1981). As the field matured and the role of IT became more critical to the success of the organization, the position of CIO emerged in the early 1980s (Synnott and Gruber, 1981). This transition from EDP managers to CIOs highlighted the importance of IT and linked the data processing units with organizations' TMTs (Bock, Carpenter, and Davis, 1986).

A number of researchers took initiatives geared towards defining and articulating the role(s) of the CIO. For instance, Rockart, Ball, and Bullen (1982) provided a synopsis of the future role of the CIO in the 1980's, while Benjamin, Dickinson, and Rockart (1985) investigated the changing role of Corporate Information Systems Officer. The status that was accorded to the data processing managers by being elevated to the CIO position was similar to an earlier industry development that had taken place 20 years earlier, where accountants were promoted to the position of Chief Information Officers (Hunter, 2010).

The CIO, as a member of the TMT, is responsible for IT resource planning, strategizing, and management. Although there are other developments that have impacted the IS field as shown in Table 1, the emergence of the position of an IT leader ranks among the top. The importance attached to the position of an IT leader is exemplified by the fact that the capability of an organization to seamlessly assimilate the changes brought about by these developments is premised on the effectiveness of the IT leadership. For instance, the dot com/Internet boom period of 1995-2000 led to the proliferation of IS resources and, consequently, increased demand for IT personnel, increased IS enrollments, and thus more effective IT leadership in the US. Moreover, such developments as the Y2K problem and government legislations have forced many firms to place top IT personnel at the helm of coordination of IT compliance initiatives. Obviously, efficient and effective compliance with these government legislations should give firms a competitive advantage.

The events depicted in Table 1 and other industry developments have led many firms, not only to hire or create the position of an IT leader but also, to designate IT leaders as members of the TMTs. For instance, a preliminary analysis of the 2010 Fortune 100 firms (of these 100 firms, we successfully identified the names and titles of 92 IT leaders and education backgrounds of 48 of these 92 IT leaders) revealed that more than eighty percent (80%) of these firms have an IT leader who is also a member of the TMT.

In spite of this fact, there is limited literature on IT leadership, and most of the existing IT leadership literature is mostly based on data generated from practitioners' sources such as Gartner and Forrester Group; individual profiles from magazines such as *CIO, CW, IW* (Banker et al., 2011); qualitative interviews with IT leaders (Gefen, Ragowsky, Licker, and Stern, 2011; Sobol and Klein, 2009); or surveys of TMT members (Enns, Huff, and Golden, 2003), which usually yield small sample sizes as shown in Table 8 in the appendix. Furthermore, from our literature review, there seems to be limited academic research literature that looks at the hiring trends and education backgrounds of the IT leaders; mostly because of the inherent difficulties associated with data collection in this kind of research.

However, there is consensus that, because IT leaders spearhead organizational ITG practices, they should possess, among other qualifications, credentials that aid in the evaluation and oversight of the IT and business alignment linkages. Thus, in the following section, we discuss the educational credentials/levels of the top management teams, and more specifically the IT leaders.

Period	Event
1950s-1960s	Mainframe computers introduced into the back offices of business organizations. The goal was to speed processes, cut costs, and reduce human errors inherent in repetitive tasks (Ross and Feeny, 1999).
1950s-1960s	MIS/IS emerged as a distinct academic discipline that combined concepts from computer science, management, organizational theory, operations research, and accounting (Davis and Olson, 1985). MIS/IS is recognized as an academic discipline and integrated into business schools in the US and Informatics departments in Europe (Hirschheim and Heinz, 2012).
1968-1975	ARPANET which later became known as the Internet debuted (Leiner et al. 1997).
1970's	Application of computing into businesses led to the emergence of IT oriented managers referred to as Functional IT heads, IS managers, or Electronic Data Processing (EDP) managers (Nolan, 1976; Ives and Olson, 1981).
1972-1982	First official graduate IS curriculum was published by ACM in 1972 (Ashenhurst 1972). ACM published the first curriculum for an IS undergraduate degree in 1973 (Couger 1973). In 1982, ACM published an updated undergraduate IS curriculum (Nunamaker, et al. 1982).
Early 1980's	The term CIO was coined by Synnott and Gruber (1981). They suggested that a CIO should be a member of the TMT and should actively participate in organizational policy development and strategic planning, manage IS resources, plan, and develop new IT systems.
Early to Mid-1980's	Rockart, Ball, and Bullen (1982) provided a synopsis of the future role of the CIO in the 1980's while Benjamin, Dickinson, and Rockart (1985) investigated the changing role of Corporate Information Systems Officer.
1981	IBM introduced the PC, which eventually revolutionized computing by enabling the transition from main frames to PC based computing.
1995-2000	Dot com/Internet boom resulted in demand for IS employees, a sharp rise in number of awarded bachelors and masters degrees, and a rise in IS employment in the US (Ward, 2006).
1998-2000	Y2K problem led to a high demand for IT personnel (Luftman and Kempaish, 2007).
2000-2002	Dot com/Internet bubble bust and start of off-shoring & outsourcing resulted in decreased demand of the IS work force in the US (Bureau of Labor Statistics, 2006).
2002-2003	SOX Act placed demands on organizations to meet compliance requirements such as security of accounting and financial data and information (Damianides, 2005); consequently, the IT personnel were tasked with the roles of designing and implementing strategies to meet these conditions.

Table 1: Major Relevant Developments and Events that have Impacted the IS Field

2.2 Educational Credentials

Educational credential/level refers to the highest educational achievement by an individual. For quite some time now, management researchers have assessed the educational credentials of top executives in order to decipher their knowledge, experience, and skills base. Research undertaken in the past (Hitt and Tyler, 1991; Wally and Baum, 1994) revealed that more educated firm executives exhibited greater cognitive complexity—a trait that is generally associated with the ability to absorb and synthesize new ideas, thereby suggesting their propensity to accept innovations (Barker and Mueller, 2002). Other studies have confirmed that more innovative firms are led by TMTs with higher levels of education (Bantel and Jackson, 1989; Kimberly and Evanuisko, 1981; Thomas, Litschert, and Ramaswamy, 1991). As such, the resultant literature has tied educational levels to attributes that include cognitive ability, capacity for information processing (Guthrie, Grimm, and Smith, 1991), tolerance for ambiguity, and openness to new and innovative ideas (Bantel and Jackson, 1989; Hambrick and Mason, 1984; Wiersema and Bantel, 1992).

This study conceptualizes educational credentials as the level of formal education attained by the IT leader at the time of hire. As such, measures of these credentials will include types, numbers, and levels of degrees and certifications received by IT professionals. Hambrick and Mason (1984) argued that it was the "amount" and not the type of formal education of a management team that was positively associated with innovation. Additionally, Bantel and Jackson (1989) found that banks that were led by managers with higher levels of education also tended to be more innovative. Innovation is a firm strategy that calls for managers who are creative, open minded, risk takers, and tolerant to ambiguity; all these characteristics are closely related to the educational attainment and experience of the executives. Bantel and Jackson (1989) support this stance and argue that firms that are more creative or innovative are usually associated with TMTs that possess higher education. Hence, by collecting and analyzing the types, numbers, and levels of the degrees and certifications, we aim to capture various facets of the IT leaders' educational credentials. Milliken, Bartel, and Kurtzberg (2003) proposed that divergent thinking is associated with creative processes; hence, the more varied the educational credentials, knowledge, and skill levels of the IT leaders, the deeper and wider the pool from which they can draw informed IT governance decisions.

Just like CFOs who are expected to have significant skills in accounting (our analysis of CFOs from the 2010 Fortune 100 firms revealed that almost 90% of the CFOs have an undergraduate degree in accounting, finance or

economics and a graduate degree in business or are certified public accountants); VPs of sales who are expected to have expertise in sales & marketing; similarly, IT leaders are expected to have significant, deeper background and expertise in IS. However, since IS spans many spheres of the organization—from management, accounting, marketing, research and development, sales tracking, to customer relationship management—IT leaders are implicitly expected to be, "jacks of all trades." Thus, IT leaders with more extensive knowledge, experience, and skills that extend within and beyond the IS functions are better equipped to deliver business value through IS (Rasmussen, 2007). These traits make IT leaders more reliable partners and not subordinates of the other top level executives who are key players in corporate governance.

The educational level of IT leaders has the potential to impact in numerous ways their operational and managerial skills and abilities. To begin with, education contributes to their knowledge, perspectives and ability to comprehend technical as well as abstract IS and business concepts. Moreover, the attainment of a Bachelors, Masters, or terminal degree demonstrates an IT leaders' ability to persevere in challenging intellectual activities. For instance, James Dallas (King, 2011), a SVP of quality and operations at Medtronic Inc., argues that although a graduate degree such as a MBA gives candidates for leadership positions an edge, what he considers significant is when and how the potential leaders got their graduate degree. He points out that someone who acquired a MBA by attending night/weekend classes, while working and supporting a family demonstrates a person who can concurrently manage multiple priorities, which is a key trait for an effective leader (King, 2011).

Multi-tasking is a key part of the role of an IT leader. In the course of fulfilling their obligations to the firm, IT leaders interact internally and externally with CEOs, CFOs, COOs and other members of TMTs. Such interactions are enhanced by the networking and team building skills that these leaders acquired during their school years. Instructively, Applegate and Elam (1992) argue that IT leaders should possess, among others, networking and team building skills which are in line with their roles as mentors, communicators, and organizers. It is with this background, that this research evaluates the skills and characteristics of IT leaders by exploring their credentials and educational backgrounds. This process is accomplished through the collection and analysis of firm level longitudinal data as explained in the following section.

3. RESEARCH METHOD

3.1 Sample and Data Collection

To investigate the hiring trends and the educational backgrounds of the IT leaders, this research adopted an exploratory approach based on firm level panel data. An event-study methodology was utilized to generate the data using Lexis-Nexis wire index. Searches were conducted using the keywords "*new*" or "*create*" together with the following position titles: c*hief information officer* (*CIO), chief technology officer* (*CTO), vice president (VP) of information technology*, *VP of information services*, and *VP of information technology*. The adoption of this method was based on the fact that most firms issue a press release when they hire Senior Executives (Fee and Hadlock, 2004). We also searched for information that might have indicated that the firms fired, terminated, or transferred their top IT executives before hiring news ones.

This event-study strategy has been used by many researchers to study a variety of research issues. For example, Chatterjee, Richardson, and Zmud (2001) used a similar method in a study that investigated the market reaction to the hiring of IT leaders, while Khallaf and Skantz (2011) extended their data to study and analyze how the market reacts to IT expertise in the firms. Different position titles were used to capture the different designations that firms employed for their senior most IT executives. To ensure that the positions were associated with senior IT executives, the researchers scrutinized in detail the search results for the descriptions of roles, responsibilities, and reporting structures. The time period covered in this study was 1997-2007.

3.2 Data Analysis

The search generated announcements that were saved in a Microsoft Word document (refer to Tables 9 and 10 in the appendix for sample announcements). The methodology used for the data extraction is explained as follows. Each document was reviewed by the authors separately and the extracted data entered into a Microsoft Excel worksheet with the entries for company name, IT leaders' title, hire date, educational levels and related majors, schools attended, and other pertinent information. The information collected was evaluated and in cases of disagreements or ambiguity, the authors reviewed the announcements together in order to reach a consensus. Eventually, the data were merged into one document before proceeding with the analysis. While this manual process was time consuming, it provided better information than automated data retrieval "bots" which may omit some information and present ethical challenges (Allen, Burk, and Ess, 2008).

4. RESULTS

4.1 IT Leaders' Titles and Hiring Trends

A total of 1299 announcements were made by firms following the hiring of a senior IT executive during the period 1997-2007. As evident from these announcements, the IT titles that were used by firms to refer to their highest IT leaders and the respective percentage totals are shown in the following table, Table 2. In total, 16 different titles were used to designate an organization's top IT executive (IT leader). Table 13 in the appendix provides a detailed list of the various acronyms and their meanings.

Based on the results in Table 2, a vast majority of these IT leaders had the title CIO (58.1%) followed by CTO (33.9%), with the other 8.0% representing titles such as Senior VP of IT/IS. However, there were only four (4) positions that had President (CIO & P and CTO & P).

Table 3 shows the different positions that the firms in the study sample filled during the 1997-2007 period and their breakdown based on the titles, while Figure 1 shows the corresponding hiring trends for all these positions during the same period.

Given the fact that many business schools and departments also use different titles to designate their programs (Koch et al., 2010), it was not surprising that 16 different titles were used to refer to the top IT executives in these firms. The range of job titles is also reflective of the fragmented nature of IS which is demonstrated in studies of IS concepts where terms such as information technology (IT), information systems management (ISM), and information systems and technology (IST) are often used interchangeably (Fitzgerald, 1993; Lukic and Adzemovic, 2009). Although Firth et al. (2011) argue that this inconsistency might lead people not to clearly comprehend what comprises IS, we point out that IS is a multifaceted discipline that integrates concepts from many other fields, and that the predomination of IS is demonstrated by the latest innovations and evolution of the PC, Internet, Web 2.0 tools, and other technologies which have changed how we interact and live.

From the results in Figure 1, we infer that the hiring trend shows a significant growth around the Y2K (years 1998-2000) period but a decline following the dot com bubble burst (years 2001-2003). Additionally, there was another period of distinct growth surrounding the economic boom associated with the 2003-2005 periods.

Title *(for CIOs)*	**%**	**Title *(for CTOs)***	**%**	**Title *(for non-CIO/CTOs)***	**%**
Chief Information Officer (CIO)	23.9	Chief Technology Officer (CTO)	21.8	Senior Vice President of Information Technology (SVP-IT)	4.2
Chief Information Officer & Vice President (CIO & VP)	17.2	Chief Technology Officer & Vice President (CTO & VP)	5.3	Vice President of Information Systems (VP-IS)	2.4
Chief Information Officer & Senior Vice President (CIO & SVP)	12.5	Chief Technology Officer & Senior Vice President (CTO & SVP)	4.1	Senior Vice President of Information Systems (SVP-IS)	0.5
Chief Information Officer & Executive Vice President (CIO & EVP)	4.4	Chief Technology Officer & Executive Vice President (CTO & EVP)	2.5	Vice President of Information Technology (SVP-IT)	0.5
Chief Information Officer & President (CIO & P)	0.1	Chief Technology Officer & President (CTO & P)	0.2	Executive Vice President of Information Technology (EVP-IT)	0.3
				Director of Information Technology (D-IT)	0.1
CIO Totals	***58.1***	***CTO Totals***	***33.9***	***Non-CIO/CTO Totals***	**8.0**

Table 2: Titles Designating Top IT Executives

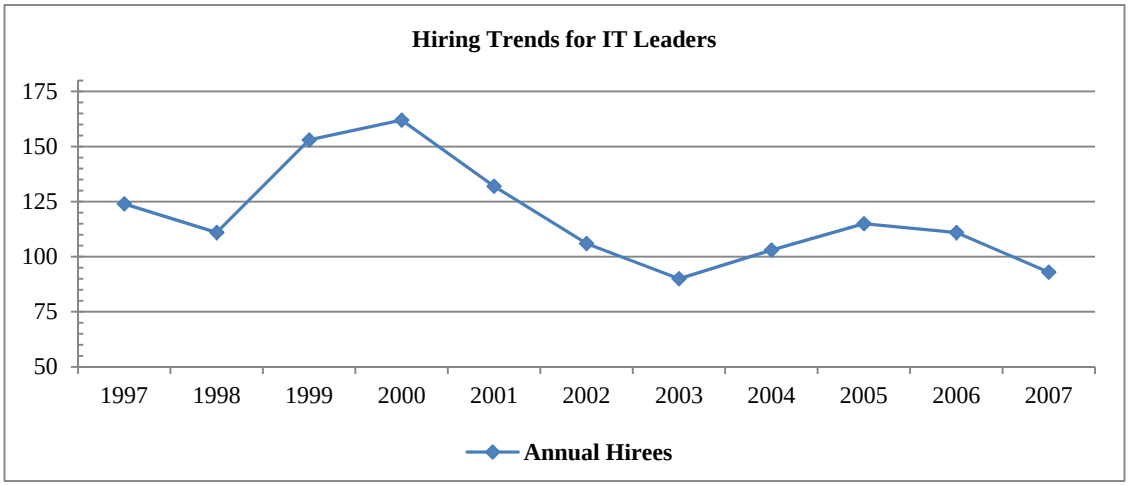

Figure 1: A Graphical Representation of the Annual Hiring Trends

Years	Position Titles																
	CIO	CIO &VP	CIO & P	CIO & SVP	CIO & EVP	CTO	CTO & VP	CTO & SVP	CTO & EVP	CTO &P	D-IT	IT & EVP	IS & VP	IS & SVP	IT & VP	IT & SVP	**Annual Total**
1997	25	31	1	12	8	11	7	6	1	0	0	0	11	1	10	0	124
1998	26	28	0	17	6	13	4	2	3	1	0	0	4	2	4	1	111
1999	36	36	0	20	5	28	7	6	2	1	0	0	4	2	4	2	153
2000	40	25	0	16	6	44	8	8	4	0	0	0	1	0	10	0	162
2001	29	17	0	16	2	40	12	5	2	1	0	0	1	0	4	2	132
2002	24	17	0	16	5	27	7	3	2	0	0	0	1	0	4	0	106
2003	19	15	0	11	3	20	7	4	2	0	0	1	2	1	5	0	90
2004	30	18	0	6	2	26	3	7	3	0	0	1	4	0	3	0	103
2005	24	16	0	21	7	21	6	3	6	0	0	0	1	1	6	3	115
2006	30	13	0	13	11	27	5	3	6	0	0	0	1	0	2	0	111
2007	28	7	0	15	2	26	3	6	2	0	1	0	0	0	3	0	93
Total	**311**	**223**	**1**	**163**	**57**	**283**	**69**	**53**	**33**	**3**	**1**	**2**	**30**	**7**	**55**	**7**	**1299**
%	23.9%	17.2%	0.1%	12.5%	4.4%	21.8%	5.3%	4.1%	2.5%	0.2%	0.1%	0.2%	2.3%	0.5%	4.2%	0.5%	100%

Table 3: Annual Distribution of IT Leaders' Hiring Statistics (1997-2007)

The SOX Act was enacted in 2002, and it is possible that the growth in hiring around the 2003-2005 period was driven by the organizations' compliance strategies. There was a noticeable decline after the year 2000 (2001-2003 period), which is not surprising because it reflects the Internet bubble burst period as well as the end of the hyped Y2K scare period. Out of these 1299 positions, 254 (20%) were newly created. As expected, most of these newly created positions were generated around the 1999-2000 period, which can be attributed to organizations' need to mitigate the predicted consequences of the millennium bug.

4.2 Educational Backgrounds

In order to evaluate the academic credentials of the IT leaders, the authors collected data (where available) about the bachelors, masters, and doctoral degrees, industry certifications, patents granted, as well as the institutions from which these degrees were conferred or patents were awarded. For those IT leaders whose educational and experiential data were unavailable in the initial announcements, the authors used the respective firm websites, Google finance/Reuters, and Hoovers to glean and validate some of the information. The following figure, Figure 2, shows a breakdown of the bachelor's degrees earned by the IT leaders in the sample. Out of the 1299 hires, we were able to obtain specific information about the bachelor degrees of 689 IT leaders and we include only those majors that had at least 7 or more occurrences for a sample size of 627. Out of the 627 positions, Engineering (ENGR) was the dominant major (24%), followed by Bachelor of Science (13%), while Computer Science (COSC) and Business Administration (BUAD) came third with 12% each. These values are consolidated such that the 24% value for Engineering includes electrical engineering (with 15% of the total 627 positions) mechanical engineering (4%), and "other" engineering (5%) of the total positions.

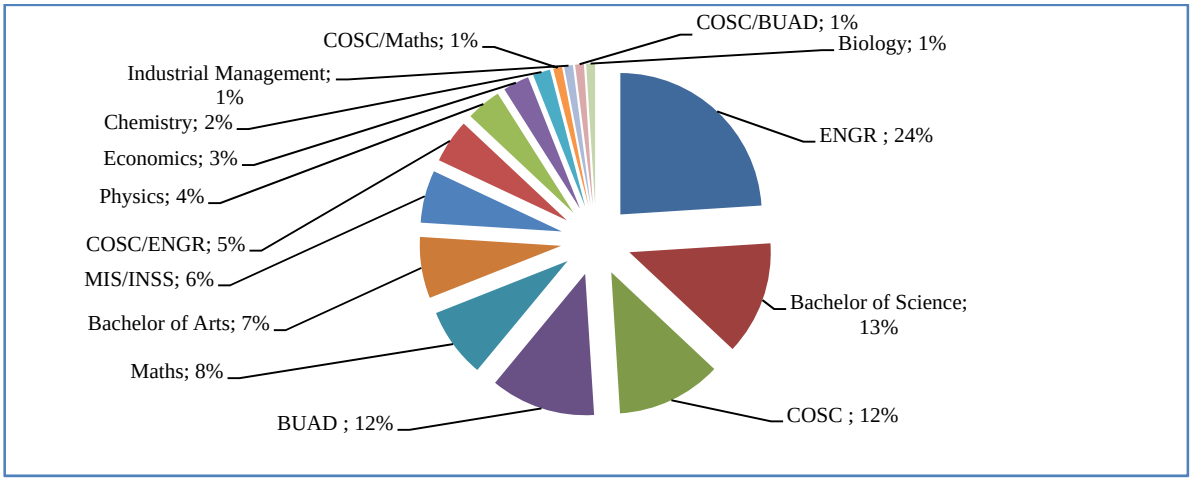

Figure 2: Figure 2: Distribution of IT Leaders Undergraduate Education Majors

Conversely, BUAD includes accounting, finance and general BUAD majors. For the Bachelor of Science and Bachelor of Arts degrees, the announcements did not specify the majors but just indicated that the person being hired had earned a Bachelor of Arts or Bachelor of Science degree.

For further analysis, firms were classified based on whether they belonged to the hi-tech or low-tech industries following the guidelines given by Francis and Schipper (1999). After comparing the two main groups of hired IT leaders, the results indicated that in all the years, hi-tech firms preferred IT leaders with the title CTOs, while the low-tech firms preferred IT leaders with the title CIOs. To test this relationship, the authors carried out a simple t-test which yielded statistically significant difference ($t=5.58$, $p<0.000$).

4.3 IT Leader Titles and Related Academic Degrees

In order to investigate the relationships between the IT leaders' position titles and the educational credentials, we generated Table 4 as shown below. The table shows the various IT leader positions and their related bachelor's degrees. The results indicate that in general, majority of the IT leaders 56% (351) earned bachelor's degrees in Science, Technology, Engineering and Mathematics (STEM) related majors (includes ENGR, COSC, MATH, PHY, CHEM, and BIO). On the other hand, there were only 16% (102) and 6% (36) IT leaders who had bachelor's degrees in business (BUAD and ECON) and MIS/INSS respectively.

While comparing the total number of CIOs and CTOs (in-group), we found that out of the 369 CIO positions, 47% (172), 21% (78), and 7% (26) of the CIOs had STEM related, business, and MIS/INSS degrees respectively. The results revealed a distinct difference from the CTO positions whereby out of the 197 holders of these IT leader positions, 77% (151), 4% (8), and 3% (5) had STEM related, business, and MIS/INSS degrees respectively. Intuitively, the percentage of CIOs with business degrees (21%) was higher than that for CTOs (4%). Among the non-CIOs/CTOs group, there were 28 (46%), 16 (26%) and 5 (8%) IT leaders who earned bachelor's degrees in STEM related, business, and MIS/INSS respectively.

A further analysis of the undergraduate degrees also indicated that from the year 2000, there was an increase in the number of IT leaders who were hired with business related degrees. This rise in the hiring of business oriented IT leaders may be explained by the fact that, as IT-related jobs get outsourced, firms are requiring their IT leaders to have a better grasp of business operations and processes.

Additionally, after the year 2000, many firms ventured into e-commerce by investing in web presence infrastructures that required an IT leader to be well versed with technical as well as business aspects of e-commerce. Consequently, IS graduates should also have a better understanding of business operations and processes—skills that are needed in day to day business operations and IT management positions.

4.4 Where did the IT Leaders obtain their Undergraduate Degrees?

The search yielded 689 position announcements with information about the bachelors' degrees of which 672 entries had specific information about the degree granting institution. Table 5 shows the different IT leader positions and the schools from where different holders of these positions obtained their bachelor degrees. The schools are classified into three categories in accordance with the rankings of *US World News and Report* as shown in Table 11 in the appendix. No particular school dominates the rankings, but the results revealed that there are more schools from the Tier 3 category than there are from Tier 1 and Tier 2 categories combined.

TITLES	ENGR	COSC	MATH	PHY	CHEM	BIO	BUAD	ECON	MIS/ INSS	COSC/ BUAD	INDU/ MNGT	B.Sc.	B.A.	Total
CIO	30	28	9	3	1	1	29	3	13	4	3	16	10	150
CIO & VP	19	21	12	5	0	2	19	4	9	1	2	17	9	120
CIO & SVP	12	7	9	2	0	1	17	1	4	0	2	12	7	74
CIO & EVP	5	4	1	0	0	0	5	0	0	1	0	5	4	25
Sub-Total	***66***	***60***	***31***	***10***	***1***	***4***	***70***	***8***	***26***	***6***	***7***	***50***	***30***	***369***
CTO	52	20	10	10	3	1	2	2	3	2	0	13	7	125
CTO & VP	15	3	2	2	2	1	0	2	0	0	0	4	2	33
CTO & SVP	11	1	2	0	3	0	2	0	1	1	0	3	0	24
CTO & EVP	10	1	1	0	1	0	0	0	1	0	0	0	1	15
Sub-Total	***88***	***25***	***15***	***12***	***9***	***2***	***4***	***4***	***5***	***3***	***0***	***20***	***10***	***197***
VP & IS	2	2	3	0	0	1	3	0	2	0	0	5	0	18
VP & IT	9	5	2	0	2	0	7	4	3	0	0	2	3	37
SVP & IT	0	1	1	0	0	0	2	0	0	0	0	1	1	6
Sub-Total	***11***	***8***	***6***	***0***	***2***	***1***	***12***	***4***	***5***	***0***	***0***	***8***	***4***	***61***
Total	**165**	**93**	**52**	**22**	**12**	**7**	**86**	**16**	**36**	**9**	**7**	**78**	**44**	**627**
% Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Legend: ENGR = Engineering, B.Sc. = Bachelor of Science, COSC = Computer Science, BUAD = Business Administration, MATH = Mathematics, B.A. = Bachelor of Arts, MIS/INSS = Management /Computer Information Systems/ Information Science & Systems, PHY = Physics, ECON = Economics, CHEM = Chemistry, INDU/MNGT = Industrial Management, BIO = Biology

Table 4: Various IT Leader Titles and their Related Bachelor's Degrees

There were 89 (13%), 58 (9%), and 525 (78%) IT leaders who obtained their undergraduate degrees from a Tier 1, a Tier 2, and a Tier 3 school respectively as shown in the following table, Table 5. These values were consistent for the CIOs, CTOS, and non-CIOs/CTOs designation positions. To test the differences, the researchers employed simple t-tests which revealed no significant statistical difference between the number of degrees from Tier 1 and Tier 2 schools ($t=1.71$, $p<0.11$), but there were significant statistical differences between degrees from Tier 1 and Tier 3 ($t=3.58$, $p<0.005$), and Tier 2 and Tier 3 ($t=3.63$, $p<0.004$) schools. The results illustrate that attending a Tier 1 or Tier 2 school is not a significant factor in determining who becomes an IT leader, but the type of undergraduate credentials (STEM and business degrees) earned by IT leaders is a significant factor in determining their ascension to this position and eventual success.

4.5 Which are the Most Preferred Graduate Degrees with IT Leaders?

The distribution of the master's degree credentials obtained by the IT leaders is shown in Table 6. The search results yielded specific information about the graduate degrees of 502 IT leaders from a total of 1299 announcements. Additional analysis of the 502 announcements showed that there were 305 CIOs, 176 CTOs, and 21 IT leaders with non CIOs/CTOs designations. The results revealed that, in general, most of the IT leaders (47%) had graduate degrees in business related majors (these includes MBA, MBA/FIN, and EMBA and we hereafter refer to these degrees as MBAs), 31% had graduate degree in STEM related majors (includes MS COSC, MS ENGR, and MS PHY), and only 8% had graduate degrees in MIS/INSS. The analysis also showed that among the 305 CIOs with various designations, 51% had MBAs, 28% had graduate degrees in STEM related majors, and only 7% earned graduate degrees in MIS/INSS.

Titles	Tier 1	Tier 2	Tier 3	Total
CIO	19	12	133	164
CIO & VP	14	16	99	129
CIO and SVP	6	10	63	79
CIO & EVP	2	1	22	25
Sub-Total	*41*	*39*	*317*	397
CTO	26	10	100	136
CTO & VP	8	2	27	37
CTO & SVP	5	3	16	24
CTO & EVP	0	1	12	13
Sub-Total	39	16	155	210
IS & VP	3	0	16	19
IT & VP	6	3	31	40
IT & SVP	0	0	6	6
Sub-Total	*9*	*3*	*53*	*65*
Total	**89**	**58**	**525**	672

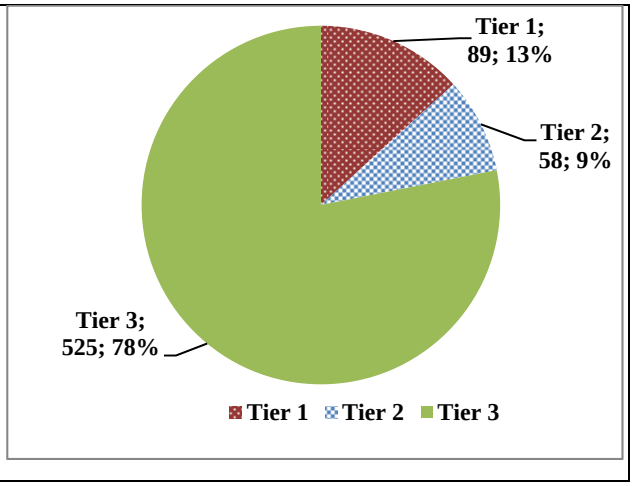

Table 5: Schools where the IT Leaders Obtained their Undergraduate Degrees

Titles	MS ENGR	MS COSC	MS PHY	MBA	EMBA	MBA/ FIN	MS COSC /MBA	MS MIS/INSS	MS	CERTS	Total
CIO	20	14	2	67	4	5	3	9	15	4	143
CIO-VP	13	9	1	19	4	0	0	1	4	2	53
CIO-SVP	11	4	1	26	2	3	4	8	11	1	71
CIO-EVP	6	3	0	24	0	0	0	4	1	0	38
Sub-Total	*50*	*30*	*4*	*136*	*10*	*8*	*7*	*22*	*31*	*7*	*305*
CTO	26	20	3	34	3	8	2	14	9	4	123
CTO-VP	5	3	1	6	0	1	1	0	1	0	18
CTO-SVP	2	2	0	8	1	1	0	2	2	1	19
CTO-EVP	1	2	1	8	0	0	0	1	3	0	16
Sub-Total	34	27	5	56	4	10	3	17	15	5	176
VP-IS	1	1	0	6	1	1	0	0	0	0	10
VP-IT	3	2	0	3	0	1	1	0	1	0	11
Sub-Total	*4*	*3*	*0*	*9*	*1*	*2*	*1*	*0*	*1*	*0*	*21*
Total	**88**	**60**	**9**	**201**	**15**	**20**	**11**	**39**	**47**	**12**	**502**

Table 6: Distribution of IT Leaders' Masters Degree by Major

On the other hand, out of the 176 CTOs with the various designations, 40% had MBAs, 38% had graduate degrees in STEM related majors, and 10% had graduate degrees in MIS/INSS. Of the 21 IT leaders with non-CIOs/CTOs designations, 57% (12) and 33% (7) had MBAs and STEM related graduate degrees respectively. The results indicate that, in general, MBA is the most popular and widely held graduate degree among IT leaders. Additionally, the results illustrate that a higher percentage of CTOs (38%), when compared with the percentage of CIOs (28%), have graduate degrees in STEM related majors. This may explain our earlier, assertion in Section 4.2, that hi-tech firms have a propensity to hire CTOs while low-tech firms prefer CIOs.

The following figure, Figure 3, shows the number of IT leaders who obtained graduate degrees in Business Administration (MBA), STEM related majors and MIS/INSS. From this graph, we can deduce that the most widely held graduate degree by IT leaders is the MBA. In general, the total number for all three types of graduate degrees follows an almost identical trend over the years in tandem with the fluctuations of the hiring trends of the IT leaders over the study period. The trend illustrates and validates the result that for all the years, MBA was the most dominant graduate degree possessed by the IT leaders. These findings are consistent with the data from the 2010 list of Fortune 100 firms in which the popular masters programs with the CEOs, CFOs, and CIOs was MBA (plus Law for CEOs and CPA for CFOs).

We also collected data about the schools/programs where the IT leaders obtained their graduate degrees. We classified the graduate schools into two categories Tier 1 and Tier 2. The particular school/program was classified as a Tier 1 if its master's program was ranked among the top 15 in the various masters' program classifications, such as the *US News and World Report*, *BusinessWeek*, *Fortune*, or *Financial Times* during the 1995-2005 periods. On the other hand, if the school or program was not classified among the top 15 in any of the rankings, we categorized it as Tier 2. This process generated a list of twenty schools under the Tier 1 category. The specific names of the schools in Tier 1 are shown in Table 12 in the appendix. Table 7 shows the IT leaders and the type of schools (classified as Tier 1 or Tier 2) where they obtained their masters' degrees. The results illustrate that the ratio of IT leaders who obtained their graduate degrees from Tier 1 (168) and Tier 2 (314) schools is almost 1:2.

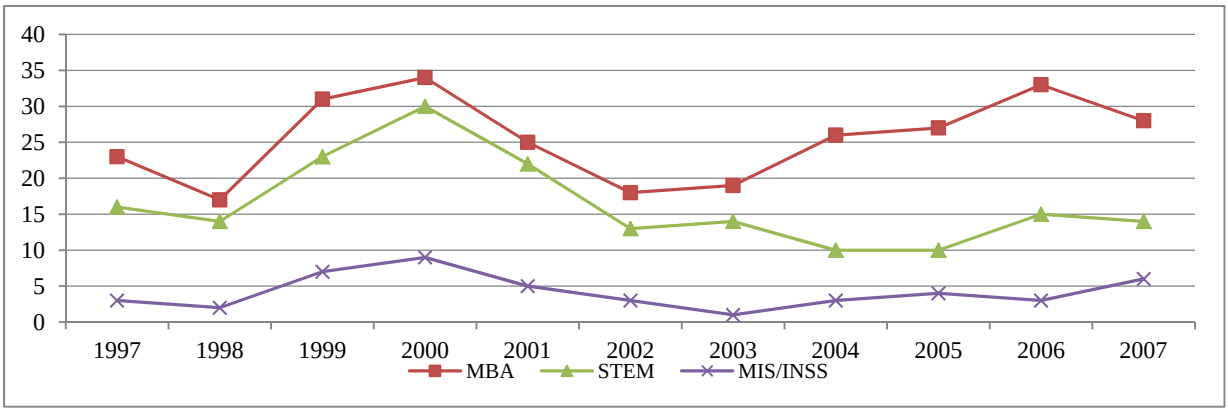

Figure 3: A Graphical Representation of the Three Main Masters Degrees Obtained by the IT Leaders

IT leader's Title	Master's Schools by Category				Total Positions
	Tier 1 #	Tier 1 %	Tier 2 #	Tier 2 %	
CIO	38	27%	101	73%	139
CIO & VP	18	38%	30	63%	48
CIO & SVP	29	44%	37	56%	66
CIO & EVP	11	29%	27	71%	38
Sub-Total	*96*	*33%*	*195*	*67%*	*291*
CTO	38	32%	82	68%	120
CTO & VP	11	61%	7	39%	18
CTO & SVP	5	28%	13	72%	18
CTO & EVP	9	60%	6	40%	15
Sub-Total	*63*	*37%*	*108*	*63%*	*171*
VP & IS	3	33%	6	67%	9
VP & IT	6	55%	5	45%	11
Sub-Total	*9*	*88%*	*11*	*55%*	*20*
Total	**168**	**35%**	**314**	**65%**	**482**

Table 7: IT Leaders' Home Graduate Programs

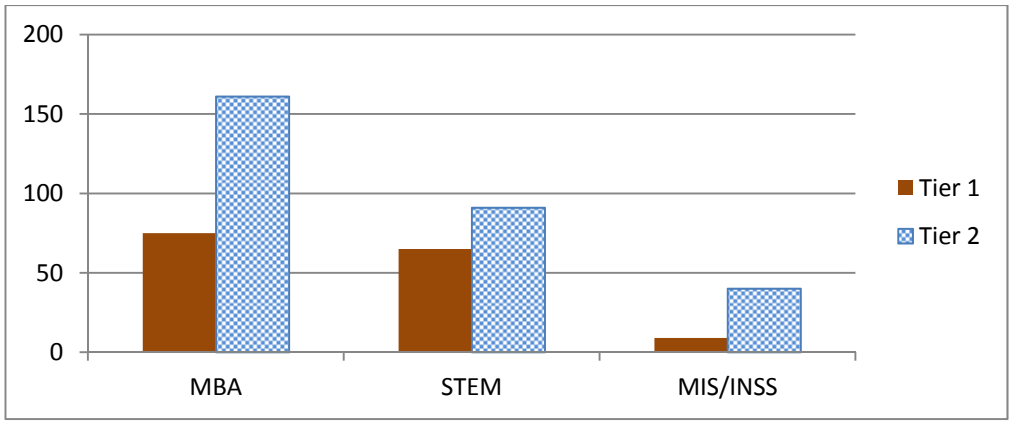

Figure 4: Masters' Programs and Related Schools

Figure 4 shows that, in total, the proportion of the Tier 1 (34%) masters' degree programs are less than those from the Tier 2 (66%) masters' degree programs implying that most of the IT leaders earned their graduate degrees from Tier 2 school programs. A simple t-test showed a significant statistical difference (t=2.1, p=0.03). However, from the 2010 list of Fortune 100 firms, the CEOs and CFOS obtained their degrees from Tier 1 schools, while the CIOs obtained their masters degrees mostly from Tier 2 schools. Additionally, most of the CFOs had accounting degrees while the CEOs had legal and economic degrees—three disciplines which have been in existence much longer than MIS.

However, from the 2010 list of Fortune 100 firms, the CEOs and CFOS obtained their degrees from Tier 1 schools, while the CIOs obtained their masters degrees mostly from Tier 2 schools. Additionally, most of the CFOs had accounting degrees while the CEOs had legal and economic degrees—three disciplines which have been in existence much longer than MIS. As such, when many of these IT leaders were graduating, the MIS discipline was still evolving and there was no universally agreed upon ranking for MIS programs. This might be a manifestation of the credibility crisis plaguing IS (Firth et al. 2011), a crisis which does not seem to affect other business school disciplines like accounting, marketing, and finance. In light of this, IS educators and practitioners should redouble the efforts of increasing the field's credibility and relevance, especially, because IS is considered as the "glue" that binds the firm together. However, this is a daunting task as IT leaders continue to earn less as compared to other C-level executives, and with only a small number reporting directly to the CEO (Nash, 2011). Also, from the data, only four IT leaders out of the total 1299 positions had the title President. This might imply that organizations have not fully recognized the role of an IT leader.

5. CONCLUSION

5.1 Key Findings

The results from this study reveal that most of the IT leaders have a technical undergraduate degree and a business graduate degree. It can be deduced, therefore, that the technical undergraduate degree equips the IT leaders with a strong foundation of IS and technical aspects of the organization, while the graduate degree in business helps them to understand the business processes, thus enabling them to relate the role of IT to the business strategy. From our data, we can also conclude that an undergraduate IS degree from a Top Tier school (Tier 1 and Tier 2) does not necessarily guarantee one a position as an IT leader.

This study found that only 13% and 8% of the IT leaders obtained their undergraduate degrees from a Tier 1 and Tier 2 school respectively; on the contrary, most (79%) of the IT leaders obtained their undergraduate degrees from a Tier 3 school. Also, there seems to be a lower number of IT leaders from graduate programs that are classified in the Top Tier graduate programs. These results are consistent with the education background of the IT leaders from the list of 2010 Fortune 100 firms. Moreover, the fact that most of the IT leaders did not graduate from Tier 1 schools is corroborated by an article that appeared in the Wall Street Journal (Evans, 2010), which reported that many firms preferred graduates from Big State universities and not Ivy League schools.

The absence of IT leaders from Top Tier schools can be explained by the fact that MIS is a relatively new discipline; hence, when these IT leaders graduated (1979-1988), many of the current Top Tier schools did not have very well established MIS programs. For instance, in ranking the disciplines according to their research output between 1986-1997, Trieschmann, Dennis, Northcraft, and Niemi (2000) reported that MIS programs at the highly rated schools (Tier 1 and Tier 2) performed very poorly. Harvard was rated 7th, Michigan 17th, University of Pennsylvania, 34th, Stanford 35th, California-Berkeley 112th while Chicago and Columbia were not even rated. On the other hand, most of the top rated programs came from Tier 3 category schools such as Georgia State at position 4 and Georgia at position 6.

Surprisingly, we did not find many IT leaders with legal degrees. Although this was unexpected given the fact that it is only in the last few years that we have witnessed a perceptible and distinct shift to IT outsourcing, off-shoring,

and contracting as a business strategy (Lacity, Khan, and Willcocks, 2009), it is likely that in the future, IT leaders might be better served if they possessed legal skills. The latest trends in IS such as outsourcing, contracting, and cloud computing involve, among others, the search, acquisitions, monitoring, negotiation, and enforcement strategies that are usually suited to an individual with a combination of legal and technical expertise—thus requiring the IT leaders to put on the hat of a contract manager. However, legal education has not been associated with innovations, unlike science and technology curricula which prepare managers to be tolerant to ambiguity and open to new ideas (Tyler and Steensma, 1998)—two traits considered to be among others, facilitators and catalysts for innovations. Obviously, innovation is an effective and indispensable competitive tool in the IS field as exemplified by Apple and Google. Currently, Operations and Project Management courses cover some of the aspects associated with contracting, acquisitions, monitoring, negotiation, and enforcement strategies. However, in order to fully capture the benefits of the current and other emerging IS innovations, IS educators should expose their students to more classes that inculcate contract management, logistics, and negotiation skills.

5.2 Implications

Even though the IS field has been experiencing a decline in enrollment, there is still a bright future and IS academics and practitioners should work together in improving the IS curriculum so that IS graduates can continue to be more competitive and effective employees. In fact, the US Bureau of Labor Statistics (BLS) has projected that the IS field will continue to grow and generate many jobs for the next decade (Bureau of Labor Statistics, 2012). This study investigated the hiring trends and the educational backgrounds of IT leaders in order to shed more light on this seemingly under-studied dimension of firm ITG. Undergraduate degrees in Science, Engineering, and Computer Science, the main academic fields that produced many IT leaders, are built around mathematics, which emphasizes a symmetric, orderly, and sequential problem-solving approach. These fields are biased towards instilling skills that are useful in producing, operating, and maintaining complex technical artifacts but lack in that they do not inculcate strategic planning capabilities, business process analysis, governance infrastructure development, and human factors (Mead and Shoemaker, 2007).

However, the strategic management of IT resources is a challenging undertaking that involves dynamic, unpredictable, and conflicting problem-solving and human relations challenges. These skills should be inculcated in both undergraduate and graduate IS programs. Programs in IS should also continue to expose the potential IT leaders to both the technical and business aspects of the firm, thus enabling them to better appreciate how to utilize IT to meet the business goals of creating value. This assertion is supported by the data which indicates that most of the IT leaders have a graduate degree in BUAD (MBA). As such, IS curricula should integrate both technical and "soft" aspects (Firth et al. 2011) in order to produce an all-rounded IS graduate who is capable of ascending to top IT leadership positions.

Moreover, as the technical and labor intensive jobs such as programming and technical support shift to overseas markets through outsourcing and off-shoring, jobs that involve the planning, design, and systems analysis are likely to remain local. These jobs favor the IS graduates because of their understanding of the business operations and processes, accounting principles, traditions, culture, and political environments of their customers' locations. In addition, IS graduates need to have an appreciation of how technical decisions impact the firm's bottom line, and this is facilitated by a combination of technical and business oriented academic backgrounds.

The results of the detailed analyses of the educational backgrounds of IT leaders imply that the field of study for both their undergraduate and graduate majors is a key factor in influencing their career success. However, the reputation of the school from where these degrees are obtained does not seem to be a significant determinant of the IT leaders' ascension to leadership positions. This is clearly evident from the fact that most of the IT leaders acquired their undergraduate degrees from Tier 3 schools and not from Tier 1 or Tier 2 schools. Additionally, most of the IT leaders obtained their graduate degrees from Tier 2 schools and not Tier 1 schools. Students, schools, career counselors, guardians, and other stakeholders should be cognizant of this fact, especially in consideration of the rising costs of acquiring an undergraduate degree from a Tier 1 or Tier 2 school or a graduate degree from a Tier 1 school. From this, we can conclude that it is the type of education and not the reputation of the school that is an influential determinant of the IT leader's success. Hence, it is very important for programs to continuously monitor, evaluate, and revise their curriculum if they have to remain competitive and meet the ever-changing demands of this dynamic field.

As the role of IT in many firms becomes ubiquitous, those mandated with managing IT resources will be called upon to transition from being technology chiefs to business executives with their main duty being the use of IT as a means of creating business value. This inevitable transition will call for a better understanding of the various aspects of business processes such as accounting, financing, human resource, logistics, and others that are necessary for comprehending return on investments from IT. These skills can be acquired through a masters degree course in IS with an emphasis on business operations and processes, or through an MBA program. Kevin Summers, Whirlpool Corp CIO, argues in an article that appears in *ComputerWorld* (King, 2011) that an MBA allows one to be viewed as a strategic business partner and adds that, based on the current and future business environment, it will be very unlikely to ascend to the position of a VP and above without an MBA (King, 2011).

For the IS undergraduates seeking a deeper understanding of business operations and processes at the graduate level, the Masters in IS model curriculum (Gorgone, Gray, Stohr, Valacich, and Wigand, 2006) has a number of courses that are geared towards instilling business concepts to the graduates. These courses are classified under two groups namely business prerequisites (financial accounting, customer oriented marketing, organizational behavior) and IS management (project and change

management, strategy and policy). However, given that the model curriculum recommendations are geared toward programs that require between 24 to 36 units (between 8 and 12 courses) for graduation, it is apparent that an MS in IS might not adequately prepare students for the business executive positions. To remedy this shortcoming, one might either seek more business oriented courses in the MS IS curriculum, or concurrently pursue an MS MIS and an MBA. We argue that IS should play a major role in graduate curriculum, and this is a challenge to both IS academics and practitioners. The urgency to popularize the IS programs is amplified by the fact that none of the schools/programs that were classified as Tier 1 in the masters category (following the *US News and World Report*, *BusinessWeek*, *Fortune* or *Financial Times* during the 1995-2005 periods) had IS as a stand-alone core/major.

Firms should hire IT leaders who have superior abilities in managing the IS resources. The ability of an IT leader is the combination of both observable and quantifiable (tangible) characteristics such as education and work experience, as well as unobservable and non-quantifiable (intangible) traits such as team-building and leadership skills. Firth et al. (2011) point out that potential IS employers are looking for graduates who, in addition to having other traits, are also effective team players and collaborators. However, identifying and measuring the abilities of IT leaders is an imprecise, difficult, and expensive process. An effective IT leader should, among other qualifications, be skilled in three main spheres: IT reasoning, strategic thinking, and internal politics (Kellen, 2007). IT reasoning requires an understanding of how to use IT in all its dimensions to create business value. Strategic thinking involves the capability to integrate people and systems together so as to achieve IT and business alignment with the goal of creating value for the stakeholders. Internal politics is the ability to successfully navigate and manage corporate politics. IT leaders who possess these three attributes are successful at building alliances with peers and negotiating with internal entities without jeopardizing IS strategic endeavors (Applegate and Elam, 1992). The first two types of skills can be acquired in a formal/informal educational setting, while the third is mostly acquired through experience.

5. 3 Limitations and Suggestions for Future Research

The IS literature has mainly used cross-sectional data from surveys, interviews, or archival sources to investigate the various facets of IT. This study uses panel data spanning eleven years from many firms which is a demonstration of the robustness and external validity of the study. However, there is still room for improvements through future studies. For example, this study focuses on the hiring trends and the educational backgrounds of IT leaders, and we acknowledge that there are other characteristics associated with the IT leaders that might have an impact on corporate ITG and IS education. Future studies should investigate such characteristics as the years of experience, age, and salaries of IT leaders, as well as firm size, firm industry reporting structures, and firm's use of IT. More studies may also investigate whether IT leaders' abilities such as education, functional background, and experience closely match those of the other members of the TMT such as CEOs, CFOs, and COOs and how they impact firm performance.

Although we applied data triangulation methods in ascertaining the educational backgrounds of the IT leaders from company websites, Hoovers, and Google financials/Reuters, we were not able to obtain information for all the IT leaders. Nevertheless, we believe that this research dataset is a good indicator of the developments that have been taking place in the IT arena. The study is based on US firms; however, future studies should explore firms from other parts of the world especially in light of the globalization phenomenon. We must point out, nevertheless, that USA is a pioneer in corporate ITG and the educational institutions in the US are highly ranked when compared with those from other parts of the world.

The study uses objective firm level longitudinal data spanning a period of 11 years (1997-2007) that includes the pre and post Year 2000 (Y2K), the dot com boom and bust years, and other significant events which have influenced the overall US economy and the IT industry. However, the IS field is very dynamic and there are a number of events and technical trends that have emerged or become mainstream after 2007 such as cloud computing, Web 2.0 tools and virtualization, all of which have impacted the IT arena. As such, future studies should strive to address these current trends while utilizing more current data.

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APPENDIX

Author	Variables	Sampling Method
Banker et al., 2011	CIO reporting structure ,CIO tenure, IT orientation, firm strategic positioning (differentiation, cost leadership)	Secondary data from 200 US IT executives (InformationWeek,1990-1993 and 2006 Fortune Global 1000)
Chen and Wu, 2011	IT management personnel capability, performance of the CIO	Survey of 218 CIOs in Chinese and Taiwanese firms
Gefen et al., 2011	Role of CIO in the world of outsourcing	A roundtable discussion of 10 CIOs at an academic conference
Hunter, 2010	Performance, evaluation, and turnover of CIOs. Culture and alignment	Interviews with 18 CIOs from Taiwan, New Zealand, and US firms
Chun and Mooney, 2009	General categories, responsibilities, attributes, skills, education, abilities, and roles of CIOs	Multiple methods-secondary data on CIO job postings from CIO magazine, Information week etc., Interviews with 17 CIOs
Sobol and Klein, 2009	CIO background, IT infrastructure, firm performance	Survey of 92 CIOs from US firms
Preston, Chen, and Leidner, 2008	Organizational support for IT, CIO's structural power, CIO's level of strategic effectiveness, CIO and TMT partnership	Survey of CIOs and CEOs in 174 US firms
Smaltz, Sambamurthy, and Agarwal, 2006	CIO role effectiveness, CIO capability, CIO/TMT engagement	Survey of CIO and other IT managers in 188 US Healthcare firms
Johnson and Lederer, 2005	Communication frequency, current/future role of IT, IT financial contribution	Survey of CEOS and CIOs in 204 US firms
Enns, Huff, and Golden, 2003	CIO technical background and influence behavior	Interview with 14 CIOs and members of TMTs and survey from 69 CIOs in US and Canadian firms
Leidner, Beatty, and Mackay, 2003	CIOs' IT management strategies (extend IT lifecycle, bulletproof IT infrastructures, clean house, maintain legacy systems)	Interviews with 20 CIOs from US based firms
Byrd and Turner, 2001	IT personnel skills (technology management skills, business functional skills, interpersonal skills, technical skills)	Survey of Senior IT executives in 207 US Fortune 2000 companies
Chatterjee et al., 2001	New CIO hires, firm IT strategy	Newly created CIO positions in 113 US firms (Lexis-Nexis Wire Index)
Armstrong and Sambamurthy, 1999	CIO reporting relationship, membership in TMTs, CIOs IT and business knowledge	Survey of IS and business executives in 235 US firms (fortune 500 and business week 1000)
Karimi, Gupta, and Somers, 1996	CIO's rank, strategic orientation	Surveys of IT leaders in 213 US Banks
Boynton, Zmund, and Jacobs, 1994	IT use, Managerial IT knowledge, IT management processes	Survey of Senior IT managers in 132 US firms
Earl and Feeny, 1994	CIO value, qualities of CIO	Interviews and survey of CIO and CEOs in 60 US firms
Applegate and Elam, 1992	Backgrounds, experience, reporting relationship of old and new CIOs	Survey of new and old senior IT managers in 99 US firms
Feeny, Edwards, and Simpson, 1992	CIOs and CEOs relationship	Interviews of CIOs and CEOs in 14 large UK firms
Stephens, Ledbetter, Mitra, and Ford, 1992	CIO role in TMT, CIO power in resource allocation	Interviews of CIOs from 5 US firms
Raghunathan and Raghunathan, 1989	Rank/role of IS manager, IS planning dimensions, strategic role of IS	Survey of IS managers in 192 US firms

Table 8: A List of Past Research Investigating Various Dimensions of IT Leadership

The following tables, Tables 9 and 10 contain the results that were returned by the search procedure on the Lexis-Nexis database. For instance, table 9 shows an announcement of the creation and hire of a new CIO position that was made by LMI Aerospace President and CEO and appeared in the PR Newswire in August 20th, 1999. Among the information contained in the announcement about the CIO is the years of experience, industry experience, earned bachelor's degree, school attended, and so on.

PR Newswire

August 20, 1999, Friday - 11:16 Eastern Time

LMI Aerospace Names **Mike Biffignani to Post** of Chief **Information Officer**

SECTION: Financial News **LENGTH:** 406 words **DATELINE:** ST. LOUIS, Aug. 20

LMI Aerospace, Inc. (Nasdaq: LMIA) today named Michael **Biffignani,** a 16-year veteran of the **aerospace** industry, to the position of Chief **Information Officer.**

In his newly created position, **Biffignani** will focus on leveraging technology to build relationships between **LMI** and its key customers and suppliers, facilitating greater efficiency and electronic commerce activities. He succeeds Ed Stuart, who retired as manager of management **information** services.

Ronald S. Saks, president and chief executive **officer of LMI,** said, "**Mike** is a perfect fit for this important new position. He brings in-depth knowledge of supplier management systems and electronic commerce strategies, both of which will benefit **LMI Aerospace** significantly. **Mike** will move **LMI** into the forefront of technology, which is imperative to maintaining our competitiveness."

Prior to joining **LMI, Biffignani** was an **information** systems director for Boeing's Defense and Space Business Unit, a position he held for three years. He was responsible for designing, developing and testing a new supplier management and procurement system. In that role, he re-engineered Boeing's Defense and Space supply chain management process, and developed electronic commerce strategies and tools.

He spent most of his **aerospace** career with McDonnell Douglas, and continued with Boeing when it acquired McDonnell Douglas. He participated in McDonnell's Executive Development Program and managed business operations at one of McDonnell Douglas's manufacturing facilities, among other positions.

Biffignani worked in the Sony Professional Products division of Sony America prior to joining McDonnell Douglas. He earned a bachelor's degree in electrical engineering from the University of Missouri, Rolla, in 1979.

LMI Aerospace, Inc., which went public June 30, 1998, is a leading supplier of quality components to the **aerospace** industry. **LMI** is one of the largest suppliers of structural and interior sheet metal components and assemblies to the aircraft industry. The company operates five manufacturing facilities that fabricate, finish and integrate close tolerance aluminum and specialty alloy components for commercial, corporate, regional and military aircraft. **LMI Aerospace,** based in St. Charles, Mo., was founded in 1948.
SOURCE LMI **Aerospace,** Inc.

Table 9: LMI Aerospace Creates and Hires a new Chief Information Officer

PR Newswire

August 7, 2000, Monday

Niku Names Former **Oracle and Listen.com Executive** as New Chief **Technology Officer**

SECTION: FINANCIAL NEWS **LENGTH:** 422 words **DATELINE:** REDWOOD CITY, Calif., Aug. 7

Niku Corporation (Nasdaq: **NIKU)**, a leading provider of Internet solutions for the sourcing, management and delivery of professional services, today announced that Mark Moore, 35, has joined the company as chief **technology officer.**

In his new position as CTO, Moore will be responsible for **Niku's** development vision, architectural direction and new **technology** integration. Moore will report to Rhonda Dibachi, **Niku's** senior vice president of Development.

Moore brings 14 years of experience in application and database design to **Niku.** Before joining **Niku,** Moore was vice president of Engineering and founding member of music directory Web site **Listen.com.**

Prior to **Listen.com,** Moore was a co-founder and vice president of Development at Diba. He also served as Director of Interactive Services for **Oracle's** Media Server Division. Moore held engineering positions at Control Data Corporation and Geophysical Corp. of America and holds a B.S. in Computer Science from Northwestern University in Evanston, Illinois.

"Mark's extensive background in databases, applications and the Internet makes him well-suited to direct the continued advancement of **Niku's** fundamental **technologies,**" said Rhonda Dibachi, senior vice president of Development for **Niku.** "Mark's technical expertise, creative vision and leadership capabilities make him an essential addition to our team."

About **Niku**
Niku Corporation provides Internet software products and online marketplaces for the sourcing, management and delivery of professional services. **Niku's** Internet software products are designed to automate the core business processes of professional services organizations, professional services providers within enterprises, small businesses and individual professionals. **Niku** customers include industry-leading firms such as Bell Atlantic, Cisco Systems, Computer Associates, Tata Consultancy Services and Xerox Connect.

NOTE: **Niku, the Niku** logo, iNiku, iNiku.com, eNiku, xNiku and **Niku** Services Marketplace are trademarks of **Niku** Corporation in the United States and other countries. Any other product brand names used are property of their respective owners.

SOURCE **Niku** Corporation

Table 10: Niku Corporation Hires a new Chief Technology Officer

Tier	University/College	Tier	University/College	Tier	University/College
1	MIT	2	Pennsylvania State University	3	Rensselaer Polytechnic Inst.
1	Stanford University	2	University of Wisconsin-Madison	3	N. Carolina State University
1	UC- Berkeley	2	U. of Maryland College Park	3	Rice University
1	California Inst. of Tech.	2	Harvard University	3	University of Washington
1	UI - Urbana-Champaign	2	UC-Santa Barbara	3	University of Florida
1	Georgia Inst. of Tech.	2	University of Southern California	3	University of California-Davis
1	University of Michigan	2	University of Minnesota	3	Washington U.- St. Louis
1	Cornell University	2	Northwestern University	3	Yale University
1	Carnegie Mellon U.	2	Johns Hopkins University	3	U. of Massachusetts - Amherst
1	U. of Texas at Austin	2	Virginia Poly Inst. & State U.	3	Michigan State University
1	Purdue University	2	Ohio State University	3	Iowa State University
1	UC- San Diego	2	University of Virginia	3	University of Arizona
1	UC- Los Angeles	2	Columbia University	3	University of California-Irvine
1	Texas A&M University	2	University of Pennsylvania	3	U. of Colorado-Boulder
1	Princeton University	2	Duke University	3	*Other Schools and Colleges*

The schools are classified into three categories following the rankings of *US World News and Report*

Table 11: Top Engineering /Computer Science Schools (Undergraduate)

Tier	University/College	Tier	University/College
1	Harvard University	1	University of North Carolina-Chapel Hill
1	Stanford University	1	University of California-Berkeley
1	University of Pennsylvania	1	Dartmouth College
1	Northwestern University	1	University of California- Los Angeles
1	Columbia University	1	Yale University
1	Duke University	1	New York University-Stern
1	University of Virginia	1	University of Southern California
1	MIT	1	Carnegie Mellon University
1	University of Chicago-Illinois	1	University of Texas at Austin
1	University of Michigan	1	Cornell University

The particular school/program was classified as a Tier 1 if the master's program was ranked among the top 15 in the various masters' program classifications, such as the *US News and World Report, BusinessWeek, Fortune* or *Financial Times* during the 1995-2005 periods. On the other hand, if the school or program was not classified among the top 15 in any of the rankings, we classified it as Tier 2 programs.

Table 12: Top Masters Programs (Business/Engineering/Technology)

Acronym	Meaning
BUAD	Business Administration
CEO	Chief Executive Officer
CERTS	Certifications
CIO	Chief Information Officer
COSC	Computer Science
CTO	Chief Technology Officer
EMBA	Executive Masters of Business Administration
ENGR	Engineering
EVP	Executive Vice President
FIN	Finance
HIPAA	Health Insurance Portability and Accountability Act
IS	Information Systems
IT	Information Technology
ITG	Information Technology Governance
MBA	Masters of Business Administration
SVP	Senior Vice President
TMT	Top Management Team
VP	Vice President
Y2K	Year 2000

Table 13: A list of Acronyms and their meanings