Powerful Technology Leadership and Growing the Top Line

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Abstract

Technology advancements in the marketplace creates both challenges and opportunities for firms. Having an influential technology specialist within the top management team can allow firms to better identify, diagnose and capitalize on changes caused by technology to enhance firm output. This study uses the dynamic capabilities view to examine the impact of powerful technology leaders on firm output. Effective management of technology is proposed to enable firms to better adapt to changes in the marketplace. This paper finds that the inclusion of a powerful technology leader within the top management team predicts higher levels of firm output over time. Over a five year period of time, the inclusion of a powerful technology leader was more predictive of firm output than the inclusion of a powerful marketing leader within the top management team.

Keywords (Required)
CIO, firm performance, Dynamic Capabilities View, technology change.

Introduction

Technology is changing faster than ever in the marketplace, and firms are increasingly challenged to adapt to new technology to maintain market share and capitalize on new opportunities. Technology innovation has long been considered a prominent source of disruptive innovation (Christensen 2013). However, while technology changes represent great challenge to organizations, they also present great opportunities. While technology advancement can be of benefit to firms, internal firm power struggles and organization dynamics have been found to contribute to resistance (Markus 1983). The role of power has been found to contribute to the success of organizations. The power of executives in a firm has been associated with the ability to drive strategic change (Hambrick and Finkelstein 1987). While substantial research has examined Chief Information Officer (CIO) reporting structure (Banker et al. 2011) limited work has been done to examine the influence of powerful technology leaders on firm performance. This research seeks to examine one aspect of power, relative salary, and to assess the impact that a powerful leader has on measures of firm performance. The research describes how firms with powerful technology leaders can impact top line performance, or sales volume, of their organizations. As firms empower technology leaders with representation among the top management teams, what is the impact on firm output, and how does that impact on output compare to other functional leadership roles?

This research examines the relationship between the inclusion of a technology leader within the firm’s highest compensated executives with firm output. Representation of technology specialists within the top management team can facilitate the execution of a firm’s technology vision (Lim et al. 2012). Technical expertise can allow firms to better identify opportunities to turn technology change into growth opportunities. Traditionally marketing has been seen as an engine to drive firm output, however in this paper we will demonstrate that firms with powerful technology leaders achieve larger sales than firms that do not, and that powerful technology leaders predict future sales more strongly than powerful marketing leaders.

Literature Review

The role of power within organizations has been explained by upper echelon theory (UET) (Hambrick and Finkelstein 1987), and constructs for measuring the power of leaders have been developed focusing on
organizational impact have been further developed by Finkelstein (Finkelstein 1992). UET proposes that in circumstances where managerial discretion is high, the skills, abilities and decisions of leaders effect firm performance, or in other words, powerful leaders can make a difference. Previous research has provided extensive insights into role of power in leadership. Jasperson et al.’s review of power in the literature identifies several types of authority: Hierarchical, Institutional, Organizational and Rational (Jasperson et al. 2002). Leaders may exercise authority within their organization according to the sources of power that they possess. Power within an organization may stem from organizational position, expert knowledge, or persuasiveness, and different types of power have been found to be used at differing levels of management (Yukl and Falbe 1991). While the sources of power and authority in an organization can vary, research of top management teams has found that relative salary is associated with a leader’s ability to undertake strategic change in a firm (Carpenter et al. 2004).

Previous research has examined CIO reporting structure and its impacts. The strategic intentions for technology within a firm has been found to contribute to whether or not a CIO reports to the CEO or the CFO, and that CIO reporting structure has been found to predict abnormal returns over limited periods of time (Banker et al. 2011). Preston et al (2008) demonstrated the varying levels of strategic authority of CIOs effects IT contributions in self-reported firm performance measures (Preston et al. 2008). Based on previous literature regarding power in organizations, it is posited that even with the same reporting structure, the power of a CIO may be very different across organizations. While many papers have addressed the interaction between senior technology leaders and the top management team, the literature as yet to focus on the inclusion CIO/CTO in the dominant coalition of firm by virtue of relative salary, as opposed to mere reporting hierarchy.

Many researchers have demonstrated that technology can have a positive impact on firm performance. Information technology investments have been shown to be positively related to a number of different firm performance measures, including Tobin’s q (Bharadwaj et al. 1999), enhanced returns relative to risk (Dewan et al. 2007), and the use of human capital (Aral and Weill 2007). While a variety of firm performance measures have been used, this research will look specifically at firm output as measured by sales. As technology advances change the dynamics of the marketplace, firms may be presented with new means of delivering value. The leverage of technology by a firm has been found to be positively associated with exploitation capabilities within firms, or firms that successfully use technology have been found to be better able to capitalize on opportunities.

Previous research has demonstrated that powerful technology leaders are associated with higher levels of firm investment. The presence of a CIO in the leadership team has been associated with higher levels of innovation (Saldanha and Krishnan 2011). Through higher levels of innovation firms can better adjust to changing business environments. Technology adoption has been found to contribute to changes in power within the organization over time (Burkhardt and Brass 1990). The inclusion of a CIO position within a firm has been positively associated with various measures of firm performance (Hu et al. 2014; Yayla and Hu 2014). The presence of a formally titled CIO within a firm has been positively associated with levels of IT investment (Lim et al. 2013). The benefits of technology skill can extend beyond a firm’s management. Technology awareness levels of the board of directors have also been found to contribute to performance. Higher levels of board awareness of IT is positively associated with firm performance, particularly in technology intensive industries (Yayla and Hu 2014). Powerful technology leaders have helped firms enter new markets, as Amazon has demonstrated with the growth of its cloud computing services. Powerful technology leaders may also help firms adapt to changing market conditions, such as General Motors efforts to bring more integration between mobile technologies and automobiles (Shin et al. 2014).

This paper seeks to expand our knowledge regarding how a powerful technology leaders can effect firm output, and to compare that impact on output to the discipline traditionally associated with expanding firm output, marketing. The findings of the analysis indicate that having a technology leader represented in the top management team is associated with higher levels of sales, and that the standardized positive impact of a powerful technology leader is greater than the standardized positive impact of a powerful marketing leader over long periods of time. This paper will presented as follows. First, we will provide an overview of theoretical influence of how technology can support dynamic capabilities of a firm, thereby providing tools to enhance firm output. Next, we will present our methodology and results. In conclusion we will present our results, discussion and research limitations.
Dynamic Capabilities Theoretical Background

The Dynamic Capabilities View (DCV) provides a framework to describe how organizations can effectively adapt to changes within their environment. Dynamic Capabilities have been defined as a “set of specific, identifiable processes” that are conducted by an organization (Eisenhardt and Martin 2000). Processes in the firm may consist of activities such as research and development, strategic planning or developing partnerships. Repeated implementation of a process allows the work to become routinized and incorporated into the operating procedures of the firm. Through the use of Dynamic Capabilities firms can better adapt to changes within their operating environment. As firms adapt to new operating environments additional capabilities can be routinized (Winter 2003). Dynamic Capabilities analyze the sources and methods of value creation for firms operating in environments of rapid technology change (Teece et al. 1997). The DCV proposes that firms that can successfully develop new capabilities will have an advantage in the market by creating deliberate learning environments (Zollo and Winter 2002). Technology is frequently cited as mechanism through which organizations can build dynamic capabilities. The use of technology has been show to support the development of dynamic capabilities (Sher and Lee 2004).

The composition of the top management team may influence a firm’s ability to develop dynamic capabilities. Previous studies have found that the background of management has influence on firm strategies and subsequent performance (Carpenter and Sanders 2002; Hambrick 2007). The experience of top management teams with technology may influence the ways in which emerging technologies are evaluated and adopted. The inclusion of a technology leader as one of the highest compensated members of the top management team may provide impetus for greater engagement in changes in the marketplace associated with technology advancements. Having a senior technology leader ranked among the highest paid executives in the firm may allow for the leader to exercise greater influence on the development of dynamic capabilities. The presence of an influential technology leader could contribute to firms “sensing” and “seizing” new opportunities (Teece 2007), thereby enhancing firm performance over time.

Hypotheses

Influential top managers with technology expertise would be better prepared to identify opportunities to leverage technology to create business value within their organizations. An influential technology leader could also enable a firm to more rapidly identify and exploit new technology opportunities (Bennis 2013). New technology developments can create opportunities for a firm that are consistent with the firm’s overarching technology vision. However, the “sensing” and “seizing” of the new opportunities afforded by emerging technologies may be enhanced by executives with technology background (Nag and Gioia 2012). It is posited that firms with powerful technology leaders would be better able to adapt to changing market conditions to increase firm output. Managing technology projects can be especially challenging, and understanding how to use personal relationships to facilitate strategic change has been found to contribute to implementation success. Powerful technology leaders may be better position to influence their peers in organizations. The relationship between power and implementation success has been found to be partly mediated by influence tactics (Lines 2007). In addition to wielding influence within their respective firms, powerful technology leaders may be better equipped to wield influence outside of their organization. A broad network of personal relationships both inside and outside the firm has been found to enhance technology leaders power and influence (Medcof 2008).

The business capabilities of technology leaders have been found to contribute to the development of business-IT partnerships (Bassellier and Benbasat 2004). Peer relationships, the ability to use peer influence and post implementation management have been found to contribute to technology project performance (Enns et al. 2001). By including a technology leader within the top management team a greater concentration of power around technology projects may be achieved. Concentrating power within the top management team has been associated with strategic change (Greve and Mitsuhashi 2007). Success at developing business savvy and strong personal relationships has been associated with technology leader’s ability to influence firm strategy. We posit that powerful technology leadership could assist the top management team in better adapting to marketplace changes created by technology advancements in the business environment, leading to higher levels of firm output over time.
Hypothesis 1: The representation of a powerful technology leader within the top management team will predict greater levels of firm output 3-5 years in the future

Enhancing firm output is a common goal for enterprises. The role of sales and marketing is traditionally focused on objectives associated with enhancing firm output. Persistent attention to marketing has been found to grow sales (Dekimpe and Hanssens 1995). As powerful leaders within the firm are dedicated to the marketing function it is posited that firms would be better able to adapt to marketplace changes, and that larger firm outputs would be observed.

Hypothesis 2: The representation of a powerful marketing leader within the top management team will predict greater levels of firm output 3-5 years in the future

As technology continues to disrupt markets in challenging ways, a powerful technology leader may allow a firm to better capitalize on new opportunities. Bill Gates once famously observed “We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten” (Schellong 2007). There may be a lot of hype around new technology introductions, and firms without mindful, competent leadership can fall into “mindless” exercises of technology experimentation (Swanson and Ramiller 2004). However, keeping an organization on track amidst the swirl of technology inspired change may require leaders with significant credibility within their organizations. Internal status associated with relatively high compensation could be a means to provide powerful leaders within the firm the clout necessary to drive strategic direction (Carpenter and Sanders 2002). It is posited that a powerful technology leader could champion strategic investments that enhance firm flexibility over time, better allowing the firm to adapt to market changes. Having flexibility to adapt to change has been found to be predictive of effective product development (Sanchez and Mahoney 1996). It is therefore posited that long term firm output would be better predicted by the presence of a powerful technology leader than it is predicted by the presence of a powerful marketing leader.

Hypothesis 3: The representation of a powerful technology leader within the top management team will have greater predictive power on firm output in 3-5 years than the representation of a powerful marketing leader within the top management team.

Methodology

Data

Data for this analysis are primarily collected from Compustat and Execucomp databases. The time horizon of the analysis for this study is from 1992-2013. Data from all industries are included and captured by fiscal year. Within the analysis firm financial results data from Compustat are paired with firm executive leadership data obtained from Execucomp for each year included in the analysis. If a firm did not have all data fields available for the year/firm combination the firm was dropped from the analysis. Based on the pairing of data this analysis includes more than 20,000 year/firm combinations.

Methodology

The analysis is conducted by breaking the hypotheses into four models. Model A tests hypothesis 1, that powerful technology leaders predict higher levels of firm output. Model B tests hypothesis 2, that powerful marketing leaders predict higher levels of firm output. Model C tests hypotheses 3, by including both marketing and technology leadership together on firm output, while model D tests both marketing and technology leadership together, while including the interaction between the two roles to control for companies which may have both a technology and a marketing leader represented within the top management team. All models are considered on both a three year, and a five year time horizon.

Model

Independent Variables

Regulatory filings with the Security and Exchange Commission for companies that are traded in US markets require reporting on executive compensation. Within regulatory reporting firms are required to report the title, compensation and tenure of the CEO, CFO and at least the next three highest
compensated executives (SEC 2011). The vast majority of named executives in financial reporting are
generalists (e.g. head of North America or Vice Chairman). However, a significant minority of firms
include functional specialists (e.g. Chief Information Officer, VP of Marketing, Chief Operations Officers)
within their in the named executive teams. The independent variables are collected from the EXECOMP
database of financial filings.

Technology leader inclusion in the top management team. Data from 1992-2013 were collected from the
EXECOMP database. All executives whose title included the word “information” or “technology” were
classified as senior technology executives. This variable was coded as “0” if there were no executives listed
who included the word “information” or “technology” in their title, or “1” if either term were used in the
executive’s title during a given year/firm combination.

Marketing leader inclusion in the top management team. Data from 1992-2013 were collected from the
EXECOMP database. All executives whose title included the word “sales” or “marketing” were classified
as senior marketing executives. This variable was coded as “0” if there were no executives listed who
included the word “marketing” or “sales” in their title, or “1” if either term were used in the executive’s
title.

Dependent Variables

Sales post 3 years, post 5 years. Sales data were collected from COMPUSTAT North America database
labeled SALE within the data set. Financial results from 1992-2013 were collected from all firms included
in the database. Sales performance for firms without a senior technology leaders represented in the
EXECUCOMP data set 3 years prior and 5 years prior to the financial years under consideration were
compared to the sales performance of firms with senior technology leaders represented in the EXECOMP
data set in the relevant years prior to the financial year under consideration. In other words, if a senior
technology executive for firm “A” was in place in 1992, the 3 year financial results analyzed data on sales
performance in 1995 for firm “A”. For the “sales performance over 5 years” the financial results analyzed
data on sales performance in 1997 for firm “A”.

Control Variables

Year. Year values are converted to a variable with values between “0” and “1”. Year values associated
with the first year of data collection study, fiscal year 1991 were coded as “0”, while year values associated
with the final year of data collection, 2013, were coded as “1”. Fiscal year values between 1991 and 2013
are assigned a value based on the year’s ratio between the start and end date of the years collected.
Converting the year data to a ratio simplifies interpretation of the relative impact of time on the variables
considered (Little 2009).

Competitive intensity. The concept of competitive intensity has been developed in the research,
examining the degree to which firms in a given industry practice aggressive competitive activities
(Barnett 1997). For this analysis we have utilized a measure of competitiveness developed by textual
analysis of 10k submissions (Li et al. 2012). This method utilized the frequency of terms associated with
competitive activities within public descriptions of the business environment by firms to assign of level of
competitive intensity between “0” and “1”. The competitive intensity framework utilized provides a level
of competitive intensity based on Fama-French industry classifications.

Industry. Industry has been found to be a significant predictor of firm activities (Rumelt 1991). This
research controls for industry by utilizing 2 digit SIC industry classification system.

Assets, Employees. In order to isolate variation that may be the result of firm size, total assets, total
number of employees also controlled. The COMPUSTAT value of AT was used to represent total assets,
the value of EMP was used to represent employees.

Firm. Significant variation in performance can be attributed to firm specific attributes. In order to isolate
the effects of technology leaders the effect of firm is included based off of the gvkey, a six digit number
that provides a unique identifier for each firm within COMPUSTAT.
Results

A linear regression model was used to examine the hypothesized effects. The 3 year and the 5 year effects were considered separately, while controlling for year, firm, assets, employees, industry and competitive intensity. Table 1 summarizes the variable coefficients, standard error and significance. Given the size of the data set, listwise deletion was used in the event of missing data points for firm and year combinations.

Hypothesis 1 proposed that firms with a technology leader within the top management team will have higher levels of firm output than firms that do not have a technology leader within the top management team. The data demonstrate that the presence of a technology leader within the top management team is predictive of higher levels of firm output. The presence of a technology leader within the top management team was associated with a rate of 854 units higher output in three years and 1164 units higher output in five years. Both values were significant at $p<.01$. Hypothesis 1 is supported.

Hypothesis 2 proposed that firms with a marketing leader within the top management team will have higher levels of firm output than firms that do not have a marketing leader within the top management team. The data demonstrate that the presence of a marketing leader within the top management team is predictive of higher levels of firm output. The presence of a marketing leader within the top management team was associated with a rate of 750 units higher output in three years and 701 units higher output in five years. Both values were significant at $p<.01$. Hypothesis 2 is supported.
Technology Leadership and Growing the Top Line

Hypothesis 3 proposes that over a 3-5 year period that having a technology leader represented within the top management team will be more predictive of firm output than having a marketing leader represented within the top management team. While the unstandardized beta weights reported in Table 1 do indicate larger weightings on technology leader representation than on marketing leader presentation, over the twenty one years of data represented in the study marketing leaders have been included in top management teams at a higher rate, making the unstandardized beta weights an inappropriate measure by which to make comparisons of the relative predictive power of the variable. Table 2 presents the standardized beta weights.

Table 1: Summary of Regression Results

<table>
<thead>
<tr>
<th></th>
<th>Model A Technology Leader</th>
<th>Model B Marketing</th>
<th>Model C Both Leaders</th>
<th>Model D With Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry structure</td>
<td>-29.66*** (3.473)</td>
<td>-35.02*** (3.471)</td>
<td>-34.86*** (4.563)</td>
<td>-29.52*** (3.472)</td>
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<tr>
<td></td>
<td>-34.88*** (4.563)</td>
<td>-29.35*** (3.472)</td>
<td>-34.90*** (4.563)</td>
<td>-34.90*** (4.563)</td>
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<td>Competitive Intensity</td>
<td>-1903** (549)</td>
<td>-2391** (716)</td>
<td>-2060*** (720)</td>
<td>-2170*** (721)</td>
</tr>
<tr>
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<td>-2391** (716)</td>
<td>-2060*** (720)</td>
<td>-2170*** (721)</td>
<td>-2159*** (721)</td>
</tr>
<tr>
<td>Year</td>
<td>1180*** (270)</td>
<td>1087*** (392)</td>
<td>1175*** (269)</td>
<td>1123*** (391)</td>
</tr>
<tr>
<td></td>
<td>1180*** (270)</td>
<td>1087*** (392)</td>
<td>1175*** (269)</td>
<td>1123*** (391)</td>
</tr>
<tr>
<td>Firm specific controls</td>
<td>-0.003 (.002)</td>
<td>-0.005* (.002)</td>
<td>-0.005* (.002)</td>
<td>-0.005* (.002)</td>
</tr>
<tr>
<td></td>
<td>-0.003 (.002)</td>
<td>-0.005* (.002)</td>
<td>-0.005* (.002)</td>
<td>-0.005* (.002)</td>
</tr>
<tr>
<td>Assets</td>
<td>.586*** (.004)</td>
<td>.575*** (.005)</td>
<td>.586*** (.005)</td>
<td>.586*** (.005)</td>
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<td></td>
<td>.586*** (.005)</td>
<td>.575*** (.005)</td>
<td>.586*** (.005)</td>
<td>.586*** (.005)</td>
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<tr>
<td>Employees</td>
<td>112.23*** (1.183)</td>
<td>125.29*** (1.544)</td>
<td>112.43*** (1.183)</td>
<td>112.43*** (1.183)</td>
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<td></td>
<td>112.23*** (1.183)</td>
<td>125.29*** (1.544)</td>
<td>112.43*** (1.183)</td>
<td>112.43*** (1.183)</td>
</tr>
<tr>
<td>Technology Leader in TMT</td>
<td>854** (261)</td>
<td>1147*** (353)</td>
<td>804** (261)</td>
<td>1100** (353)</td>
</tr>
<tr>
<td></td>
<td>854** (261)</td>
<td>1147*** (353)</td>
<td>804** (261)</td>
<td>1100** (353)</td>
</tr>
<tr>
<td>Marketing Leader in TMT</td>
<td>750*** (173)</td>
<td>701** (230)</td>
<td>725*** (173)</td>
<td>668** (230)</td>
</tr>
<tr>
<td></td>
<td>750*** (173)</td>
<td>701** (230)</td>
<td>725*** (173)</td>
<td>668** (230)</td>
</tr>
<tr>
<td>Technology*Marketing</td>
<td>-1671** (614)</td>
<td>-2118* (835)</td>
<td>-1671** (614)</td>
<td>-2118* (835)</td>
</tr>
<tr>
<td>leader interaction</td>
<td>-1671** (614)</td>
<td>-2118* (835)</td>
<td>-1671** (614)</td>
<td>-2118* (835)</td>
</tr>
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<td>$R^2$</td>
<td>.694*** 0.637*** 0.694***</td>
<td>0.637*** 0.694***</td>
<td>0.637*** 0.694***</td>
<td>0.637*** 0.694***</td>
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<td>Adjusted $R^2$</td>
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<td>0.637*** 0.694***</td>
<td>0.637*** 0.694***</td>
<td>0.694*** 0.637***</td>
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<tr>
<td>Incremental $R^2$</td>
<td>.000*** 0.000*** 0.000***</td>
<td>0.000*** 0.000***</td>
<td>0.000*** 0.000***</td>
<td>0.000*** 0.000***</td>
</tr>
<tr>
<td>N</td>
<td>25333 20568 25333 20568 25333 20568 25333 20568</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

$p<.05$  $p<.01$  $p<.001$
Table 2: Standardized Regression Coefficients

<table>
<thead>
<tr>
<th></th>
<th>Model A</th>
<th>Model B</th>
<th>Model C</th>
<th>Model D</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Technology Leader</td>
<td>Marketing</td>
<td>Both Leaders</td>
<td>With Interaction</td>
</tr>
<tr>
<td>Industry structure controls</td>
<td>3y</td>
<td>5y</td>
<td>3y</td>
<td>5y</td>
</tr>
<tr>
<td>Industry</td>
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<td>-.035***</td>
<td>-.032***</td>
<td>-.034***</td>
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<td>Competitive Intensity</td>
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<td>-.015***</td>
<td>-.016**</td>
<td>-.015***</td>
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<tr>
<td>Year</td>
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<td>.012**</td>
<td>.016***</td>
<td>.013**</td>
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<tr>
<td>Firm specific controls</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Firm</td>
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<td>-.010*</td>
<td>-.007</td>
<td>-.010*</td>
</tr>
<tr>
<td>Assets</td>
<td>.573***</td>
<td>.521***</td>
<td>.574***</td>
<td>.521***</td>
</tr>
<tr>
<td>Employees</td>
<td>.382***</td>
<td>.396***</td>
<td>.382***</td>
<td>.397***</td>
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<tr>
<td>Technology Leader in TMT</td>
<td>.011**</td>
<td>.014***</td>
<td>.011**</td>
<td>.013**</td>
</tr>
<tr>
<td>Marketing Leader in TMT</td>
<td>.015***</td>
<td>.013**</td>
<td>.013**</td>
<td>.012**</td>
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<tr>
<td>Technology*Marketing leader interaction</td>
<td>-.011**</td>
<td>-.013*</td>
<td>-.011**</td>
<td>-.013*</td>
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</tbody>
</table>

Over a three year time lag the standardized coefficient for the including a marketing leader within the top management team is .015, while the standardized coefficient for including a technology leader within the top management team is .011. Both values are statistically significant at p<.001. Over a three year time lag hypothesis 3 is not supported. Over a five year time lag the standardized coefficient for including a marketing leader within the top management team is .012, while the standardized coefficient for including a technology leader is .013. This indicates that the inclusion of a technology leader predicted higher levels of firm output over a five year lag than the inclusion of a marketing leader did. Model D examines the interaction effect when both a marketing and a technology leader are included in the top management team. In this case the interaction is negative, meaning that firms that had both of a marketing leader and a technology leader represented within the top management team tended to be smaller in terms of sales revenue than firms that did not have both technology and marketing leaders represented within the top management team. When the interaction is considered the difference between the standardized coefficients grows larger, with technology leader inclusion in the top management team providing a standardized coefficient of .019, while marketing leader inclusion was only associated with a standardized coefficient of .016. All values were statistically significant. Hypothesis 3 is partially supported by the data. Over a three year period the hypothesis is not supported, however over a five year period the hypothesis is supported.

Robustness Checks

In order to evaluate the robustness of the model additional analyses were completed on the data. We reevaluated the data using weighted least squares regression (WLS). As industry has been shown to have a significant effect on how technology is used (Brynjolfsson et al. 1994) weighting in the WLS analysis was defined two digit SIC codes. WLS identified the same relationships as significant as were observed in OLS, although the WLS technique provided higher beta values for the technology leader in the top management team variables. Utilizing WLS showed higher standardized beta weights for predicting firm output through the inclusion of a technology leader in the top management team than a marketing leader for both a three year and a five year time period. As with OLS, the difference between the predictive power of the inclusion of a technology leader within the top management team is larger at five years than at three years(.020 vs. .024) These values are significant at p<.001 Utilizing WLS all hypotheses, included hypotheses 3, where supported for both a three year and five year period. A summary of the standardized coefficients for models C and D when using WLS by industry is provided in table 3.
Discussion

The number of senior technology executives represented in the highest compensated executives at a firm has greatly increased over the 21 year time period included in the analysis. (See figure 1) The number of firms with a senior technology leaders represented in the highest paid executives reached a high of 293 out of a total firm count of 1,436 in 2007 (20.4%) before dropping down to 201 companies with senior technology executives among 1,102 companies (18.2%). Given the rise in representation of technology leaders within firm’s top management teams, greater research is required to understand the expected benefits that can be achieved through strong technology leaders.
Figure 1: Growth of Powerful Technology Leaders

Technology is changing the way that firms capitalize on opportunities in the marketplace (Christensen 2013). The voice of powerful technology executives could be a means by which firm output can be increased. The data demonstrates that over time, the predictive power of the inclusion of a marketing leader within the top management team was reduced. The standardized beta for the predictive power of a marketing leader at three years was .015, however the coefficient drops to .012 over five years. While the predictive power of the inclusion of a marketing leader within the top management team declines over time, the predictive power of the inclusion of a technology leader within the top management team increases, from .011 to .013 over time. The difference between three and five years was even more pronounced when using WLS regression, weighted by industry. When weighting by industry the standardized beta coefficients move from .020 to .024 when comparing three years with five. This further supports the assertion that technology leaders can enhance long term firm output. While technology leaders have long had responsibility for management of technology operations, there may be growing opportunities for technology leaders to identify and develop firm growth strategies. Development programs for technology leaders may find value by expanding technologists’ exposure to disciplines generally thought of as business development, such as product management and strategic planning.

Developing a flexible technology platform has long been considered a means to create value. Some researchers have likened technology investments to options pricing (Benaroch and Kauffman 1999). The data demonstrated that the relative predictive power of technology leader’s inclusion within the top management team grew stronger over longer periods of time. This supports the idea that long term technology strategies can add firm value.

Limitations and Future Research

The structure of this analysis greatly limits the number of senior technology leaders that are considered. The research model employed in this study does not include technology leaders who are not among the five highest paid executives within the firm, even though such executives may wield substantial influence in their respective organizations. Further analysis based on broader measures of technology leader’s influence may provide greater perspective of technology leaders’ contributions to firm performance.

While this model establishes that over five year periods of time, a powerful technology leader would predict higher levels of firm output than a powerful marketing leader, the research model provides little visibility to which attributes of technology leaders and technology strategy are associates with increasing
firm outputs. Future research could identify and measure the behaviors and actions of technology leaders that contribute to increasing firm output.

This model examines overall firm output, rather than growth in output. In high growth industries an examination of growth may provide more insights into the relative benefits added by powerful technology leaders versus the relative benefits of other functional specialists.

The role of technology has changed tremendously over the twenty-one years included in the study. Additional research on how the influence of technology leaders has changed over time could provide valuable insights into the role of technology leaders in enhancing firm output.

**Contributions to Research and Practice**

The Dynamic Capabilities View posits that in environments of rapid change, firms that are able to rapidly adjust to new conditions will be able to develop a competitive advantage. Technology change is one of the largest drivers of dramatic change in the marketplace (Christensen 2013) and the rate of technology change is accelerating (Swanson and Ramiller 2004). This research demonstrates that, as technology has continued to emerge as a valuable tool in developing dynamic capabilities, the presence of powerful technology leaders predicts higher levels of firm output. This research provides further evidence of the value of the dynamic capabilities view in explaining variation in firm performance.

Powerful technology leaders can be a predictor of higher levels of firm output. The implications of this finding are twofold. First, this research would indicate that powerful technology leaders are assisting their firms in making business decisions. This would imply that broad exposure to business development domains may be beneficial for aspiring technology leaders. Second, this research indicates that firms with strategies focused on growth may find benefit through elevating technology leaders to powerful roles within the top management team. Wielding influence is about more than having a seat at the table, powerful leaders also have relative compensation packages that demonstrate the technology leader's importance and influence in the organization.

**Conclusion**

Increasing firm output is a strategic objective of nearly every organization. Leaders from many functional specialties work together to find ways to achieve growth objectives. Marketing may be explicitly associated with increasing firm output, but in today’s technology supercharged world the value of business savvy technology leaders is becoming evident. This research supports the idea that over time, powerful technology leaders can be a strategic asset for increasing firm output. Powerful technology leaders do help a firm grow the top line.


