

THE CHIEF TECHNOLOGY OFFICER AS TECHNOLOGY LEADER

Chief Technology Officers play a number of expeditionary leadership roles which involve leading people outside their primary teams. The nature of those roles is analysed and directions for empirical research proposed.

The Chief Technology Officer (CTO) is the highest ranking manager in the firm charged with the oversight of technology. Some firms use other terms for the position such as Vice-President of Technology and Innovation. For convenience of discussion, the term CTO will be used here to refer generically to positions of this type. The CTO position is usually created with the intention of providing a strong voice for technology at the executive, strategy-making table (Roberts, 2001; Smith, 2003). Uttal, Kantrow, Linden and Stock (1992) and Smith (2003) emphasize that the CTO is a leadership position which should be responsible for more than just heading the technology function. The CTO has the potential to lead the whole organization on technology-related, and other, issues. Yet, most studies of technology and innovation leadership do not mention the CTO, or the nature of the role that such a person might play (Medcof, 2007). Although we know much about leadership of, and within, the technology function, we know very little about the executive leadership of technology in the context of the broader organization. As Smith (2003: p. 35) put it, "It is important that the CTO not become the senior technologist of the company. Instead, he or she is the senior business executive with a focus on technology."

This paper will help rectify this lack of attention to the CTO as a corporate leader by analyzing the activities of the CTO from the perspective of expeditionary leadership. First, expeditionary leadership will be defined and some of the research relevant to it will be briefly reviewed. It will be argued that the CTO is, or should be, an expeditionary leader. Next, the activities of CTO's as reported in the literature will be analyzed to determine the degree to which they reflect expeditionary or other kinds of leadership. This will show that CTO's are strong on some types of expeditionary leadership but, apparently, not very active in others. The implications of this for research and practice will be discussed. The definition of expeditionary leadership is the first order of business.

Expeditionary Leadership

Leadership is the process of forming a vision of the future, communicating it to others and engaging them in activities intended to achieve that vision (Elenkov, Judge & Wright, 2005; Kotter, 1982). It is useful to distinguish between primary team leadership and expeditionary leadership. **Primary team leadership** is exercised through interactions between the leader and the people in the organizational unit of which the leader is the formal head. Primary teams include the work groups headed by first-line supervisors, project teams headed by project leaders, teams of middle-managers headed by executives, and, in the case of the CEO, the primary team is the whole organization. Leadership of the primary team is the intuitive meaning of leadership for many people. **Expeditionary leadership**, in contrast, is exercised through interactions with people outside the primary team. For the first-line

supervisor those people can include peers, middle managers, executives and others from outside the organization. For example, a first-line supervisor might take the initiative to informally ensure the effective implementation of a new quality program in her area of the plant, which had been decreed, but not very effectively led by, upper management. That first-line manager would have to spend time persuading other first-line managers, key middle managers, and quality experts from outside the organization to put extra time, effort and resources into the initiative. For the CEO, expeditionary leadership is exercised through interactions with such people as members of the board, important customers, and members of government regulatory bodies. The example of Lee Iacocca and the rescue of Chrysler is an extreme example of the kinds of expeditionary activities that most CEO's engage in as part of their normal work. Although expeditionary leadership has not been the direct focus of research to date, a great deal of very good research has been done on the kinds of activities people must engage in if they are to lead effectively beyond the bounds of their primary teams. Table 1 lists a number of the most important activities of the expeditionary leader which have been identified in the literature. The activities listed are not mutually exclusive or necessarily comprehensive, but all have relevance to the expeditionary leader and all have been the subject of well executed empirical studies, some of which are listed in the table. An important challenge for future research is to organize these activities into a coherent theoretical framework, a task beyond the scope of this paper.

The concept of expeditionary leader has been chosen for this analysis because it can help clarify the executive role of the CTO. As alluded to above in the quotation from Smith (2003), executive leadership involves more than just leading the function of which one is the head, and more than just representing that function at the executive table. Executive leadership includes elements of strategic leadership of the whole firm, working with the CEO, other executives and people from outside the firm as an initiator of activities of consequence for the firm as a whole, not just the leader's home function.

Empirical studies suggest the importance of expeditionary leadership for all managers, and that its importance increases with increasing hierarchical rank. Mintzberg's (1973) pioneering work is one such study. Mintzberg identified ten roles which CEO's perform. Of these, only three were directed to the primary team: disseminator of information to the team, resource allocator within the team, and leader of the team. Seven were of an expeditionary nature focusing outside the primary team: figurehead, monitor, liaison, spokesperson, entrepreneur, disturbance handler and negotiator. Mintzberg also found that 61% of CEOs' mail and 48% of their contact time were with parties external to the organization. Mintzberg argued on the basis of his observations, and other cited empirical research, that managers at all levels spend a large proportion of time working with people outside their primary teams. More recent data from Floyd and Wooldridge (1992, 1994, 2000) support Mintzberg. In self-report data from middle managers they found upward influence activities (expeditionary) to be more important than downward influence activities (primary team). Kraut, Pedigo, McKenna and Dunnette (2005) found evidence that although expeditionary leadership occurs at all levels of the organization, it plays a more important role at higher levels. They collected data from 1412 managers in a single large American firm (658 first-line managers, 553 middle managers, 201 executives). With factor analysis they identified seven independent activities that managers perform. Of these, three were predominantly expeditionary in nature. Of those three, two (coordinating interdependent groups and monitoring the business environment) increased in importance with increasing rank in the hierarchy; while one (representing one's staff), was of about the same importance across hierarchical levels. These results suggest the importance of expeditionary leadership for the CTO.

Table 1

Activities of the Expeditionary Leader

Expeditionary Leadership Activity	References
<p>Sense-Making</p> <p>Expeditionary leaders interact with the environment outside the primary team making sense of it to construct a mental model which is helpful in various leadership activities.</p>	<p>Pajunem (2006)</p> <p>Garg <i>et al</i> (2003)</p> <p>Baron (2006)</p>
<p>Developing a Vision</p> <p>The vision developed by the expeditionary leader through sense-making helps motivate and guide the primary team and provides a rallying point for mobilizing moral support and resources in the surrounding environment..</p>	<p>Baum <i>et al</i> (1998)</p> <p>Elenkov <i>et al</i> (2005)</p>
<p>Contributing to Broader Strategy</p> <p>The expeditionary leader contributes to the development of strategy at organizational levels above his own.</p>	<p>Broadbent & Kitzis (2000)</p> <p>Floyd & Wooldridge (1994, 2000)</p>
<p>Contributing to Shared Understanding/Behavioral Integration</p> <p>The expeditionary leader contributes to the development of shared understandings in the peer management team, and in the broader organization, the basis for strategy and action.</p>	<p>Preston <i>et al</i> (2006)</p> <p>Tan & Gallupe (2006)</p> <p>Carmeli & Schaubroeck (2006)</p> <p>Finkelstein & Hambrick (1996)</p>
<p>Contributing to Top Management Team (TMT) Activities</p> <p>The expeditionary leader with access to the top management team may contribute in various ways to the functions they perform.</p>	<p>Arendt <i>et al</i> (2005)</p> <p>Carmeli & Schaubroeck (2006)</p> <p>Finkelstein & Hambrick (1996)</p> <p>Roberto (2003)</p>
<p>Issue Selling</p> <p>The expeditionary leader may lobby to upper management to influence them on issues he believes are important, taking a sustained, strategic and well planned approach.</p>	<p>Dutton <i>et al</i> (1997, 2001)</p>
<p>Upward Influence</p> <p>The expeditionary leader uses various techniques to influence those outside the primary team.</p>	<p>Barbuto <i>et al</i> (2006)</p> <p>Shim & Lee (2001)</p>
<p>Championing</p> <p>The expeditionary leader acts as a champion in the surrounding organization for the projects she leads.</p>	<p>Howell & Boies (2004)</p> <p>Markham (1998).</p>

<p>Project Management</p> <p>Project managers inevitably exercise the skills of the expeditionary leader as they sustain their projects through the challenges that befall them.</p>	<p>Ancona & Caldwell (1988, 1992) Shim & Lee (2001)</p>
<p>Networking</p> <p>Networking skills are among the most fundamental for the expeditionary leader who must operate in uncertain and, to some extent, unstructured organizational environments.</p>	<p>Mehra <i>et al</i> (2006) Balkundi & Kilduff (2006).</p>

An examination of the examples of expeditionary leadership found in empirical studies shows it to be multifaceted in a way in which primary team leadership is not. Primary team leadership focuses on interactions with members of the primary team to accomplish the goals of the primary team. It is, more or less, a closed system. In contrast, expeditionary leadership can intend to have consequences at more than one level. In the first case, the expeditionary leader works with people outside the primary team to bring about changes which directly affect the **functions assigned to the primary team**. For example, an expeditionary leader might lobby upper management to authorize the hiring of additional people for the primary team. In the second case, the expeditionary leader works with people outside the primary team to bring about changes whose impacts are primarily for the **functions of the organization as a whole**, and only indirectly for the primary team. For example, the expeditionary leader might champion the formation of an organization-wide task force to improve the organization's record on environmental issues. Although this improvement may eventually trickle down to the leader's own organizational unit and impact it for the better, the primary thrust of the initiative was not for the benefit of his particular unit but for the benefit of the organization as a whole. These two cases, which do not have to be distinguished for primary team leadership, might be called "two faces" of expeditionary leadership.

The value of distinguishing between the two faces of expeditionary leadership is supported by examples of similar distinctions found in the research literature. Floyd and Wooldridge (1992, 1994, 2000), for example, point out the value to the organization as a whole of having middle managers play a role in formulating organizational strategy. This is quite distinct from the direct advantages for the home department which a manager might glean by participating in the strategy formulation process. Broadbent and Kitzis (2005) made the same point in their discussion of chief information officers (CIO's), who are the highest ranking executives in their organizations with oversight of information technology. CIO's are normally members of the top management team and report directly to the CEO. Broadbent and Kitzis propose that CIO's will be successful in their role only if they engage in two kinds of leadership, demand-side and supply-side. **Demand-side leadership** draws the top management team, and others, into an understanding of the role and capabilities of IT and helps set priorities for strategic IT use, thus creating a demand by the organization for appropriate IT mobilization. **Supply-side leadership** takes initiatives to develop strong IT capabilities in the organization, creating a supply of such capabilities to meet the demand. Demand-side leadership is, in this case, intended to improve the situation of the organization as a whole and the CIO is expected to take leadership because of her expertise. The exercise of demand-side leadership is intended to benefit the whole organization, not just the IT function and/or the CIO. Supply-side leadership involves managing the IT function through effective primary team leadership, and by ensuring appropriate resources for the function, through expeditionary leadership. This interpretation is consistent with the empirical work of Smaltz, Sambamurthy and Agarwal (2006) who did an empirical study of the work roles of the CIO. Through the factor analysis of questionnaire data they identified six roles of the CIO, two of which were the "strategist" and the "educator". An examination of the items which clustered under these factors shows that these expeditionary leadership activities were clearly directed to the top management team and intended to forward the organization as a whole. They are part of demand-side leadership. In contrast, another role, "relationship architect", involved negotiating and

overseeing IT-related contracts with external vendors. This is an expeditionary activity directly concerned with the functions assigned to the IT function and is part of supply-side leadership. These examples show that the two faces of expeditionary leadership are apparent in empirical studies of leadership.

But there is also evidence of a “third face” of expeditionary leadership. The two faces described above have the expeditionary leader working to affect functions assigned to the primary team and functions of the organization as a whole. The third face has the expeditionary leader working with people to affect functions external to his organization. For example, the leader might participate in an industry association which works with government and consumer groups to improve the legislation which governs the industry. A change in the legislation would very likely have an effect upon the leader’s home organization but the effect on the home organization would not be the primary intent of the change. Given the tripartite nature of the working group, the primary thrust of such changes would be to improve the societal context in which the industry operates, for the benefit of all stakeholders.

This example of the third face of expeditionary leadership brings to the fore another set of actors with whom the expeditionary leader may work, people from **beyond the organization**. They are a different group than those who are outside the primary team but in the **rest of the organization** of the expeditionary leader.

The distinctions just explained create a total of six different kinds of expeditionary leadership, as shown in Table 2. At this point we are putting aside primary team leadership activities. Table 2 represents a combination of the different people with whom the leader could work (in the rest of the organization or beyond the organization), and the places where the leadership is intended to have effects (functions of the primary team, the organization as a whole, or beyond the organization). For example, cell 1 of Table 2 has the expeditionary leader working with people in the rest of the organization (i.e. not the primary team) on functions that are assigned to the primary team. For example, the CTO may persuade other executives to increase the funding for a particular R&D project that is running over budget. In cell 2, the expeditionary leader is working with people in the rest of the organization on functions of the organization as a whole. For example, the CTO might lead other executives in taking initiatives to improve the environmental record of the firm. In cell 6, the expeditionary leader works with people beyond the organization on issues based beyond the organization. For example, the CTO may take the chair-ship of an industry/government body formed to develop industry-wide standards for emissions. Indirectly this will effect the CTO’s own organization, but the focus of this thrust is a change in the functioning of the environment beyond that organization. In summary, the framework of Table 2 is based upon a review of the general leadership literature, not on the CTO literature. It provides a broad conceptual model of what expeditionary leaders do. The next step is to review the research on technology management to determine if CTO’s are active expeditionary leaders. This will be done by populating the cells of Table 2 with items from the literature.

The CTO and Expeditionary Leadership

One possible source of job descriptions for the CTO is the literature on the leadership of innovation (e.g. Berson and Linton, 2005; Elkins and Keller, 2003; Hirst and Mann, 2004; Thamain, 2003; Mumford *et al*, 2002). A review of that literature showed that it focuses almost exclusively on primary team leadership. There was little there that could be mapped onto Table 2. Next, the literature which directly addresses the role of the CTO (e.g. Giordan and Kossovsky, 2004; Gwynne, 1996; Harris and Lambert, 1998; Larson, 1996; Roberts, 2001; Smith, 2003; Uttal *et al*, 1992) was examined and it does give significant attention to the expeditionary leadership of the CTO, as well as to some primary team leadership. The expeditionary activities described have been categorized into the cells of Table 2.

By way of contrast, the primary team leadership activities mentioned in the same papers are listed in Table 3. They are recognizably different from expeditionary leadership. The number of activities listed in Table 3 is not large but should not be taken to mean that primary team leadership is not important in technology management. The literature cited above on innovation management, and a considerable literature on technology management, gives almost exclusive attention to primary team leadership. The papers selected for review here were chosen for their attention to expeditionary leadership.

Among the papers with entries in Table 2, the one by Uttal *et al* (1992) is particularly important as it was an early advocate for the study of CTO's as leaders at the executive level. Uttal *et al* proposed three leadership roles that the CTO might play: functional, strategic and supra-functional. **Functional Leadership** involves the delivery of what is traditionally expected of an R&D function, the generation of

Table 2
Varieties of Expeditionary Leadership

<u>Locus of leadership Effects</u> (Three faces)	<u>Locus of Expeditionary Leadership Activities</u>	
	Rest of the Organization	Beyond the Organization
Functions Assigned to the Primary Team	<p>1</p> <p>Giordan & Kossovsky (2004) Intimately integrate R&D into the process of commercial development and technology integration</p> <p>Uttal et al (1992): Interface smoothly with other functions Aligns R&D and corporate strategies</p> <p>Jonash(1996) Manage linkage among corporate and business R&D functions</p>	<p>4</p> <p>Bridenbaugh (1992) Identify, access, investigate high-risk, high-return technologies</p> <p>Giordan & Kossovsky (2004) Develop global IP entity partnerships</p> <p>Smith (2003) Monitoring and assessing new technologies</p> <p>Uttal et al (1992): Scouts for technological threats and opportunities</p> <p>Jonash(1996) Lead building of external technology partnerships and alliance, balance internal and external sourcing</p>
Functions of the Organization as a Whole	<p>2</p> <p>Bridenbaugh (1992) Integrate commercial and technical strategies for existing businesses</p> <p>Giordan & Kossovsky (2004) Lead global market strategy teams Co-develop and own market and</p>	<p>5</p> <p>Smith (2003) Marketing and media relations</p>

	<p>commercialization strategies</p> <p>Develop branding concepts for products</p> <p>Smith (2003)</p> <p>Mergers and acquisitions</p> <p>Company culture</p> <p>Uttal et al (1992):</p> <p>Responds to business unit emergencies</p> <p>Makes substantial contributions to corporate strategy discussions</p> <p>Advises on mergers, acquisitions, divests</p> <p>Leads efforts to improve corporate operations through technology</p> <p>Drives cross function commercialization</p> <p>Jonash(1996)</p> <p>Manage make/collaborate/buy technology decisions</p> <p>Maximize value of technology for the company</p> <p>Bring technology into org strategy</p> <p>Keep the CEO informed on technology</p>	
Functions Beyond the Organization	3	6 Smith (2003) Government, academic and professional organizations as professional service

Table 3

CTO's Primary Team Leadership Functions Identified in Selected Literature

Bridenbaugh (1992)

Identify, access, investigate high-risk, high-return technologies possessing potential application within existing businesses and for creating new businesses
 Assure development of fundamental technologies offering clear competitive advantage for current and future businesses
 Identify; evaluate threats or opportunities contained in technical discontinuities

Giordan & Kossovsky (2004)

Value and monetize IP assets

Smith (2003)

Monitoring and assessing new technologies
 Strategic [technological] innovation

Uttal *et al* (1992):

Consistently meets budgets and schedules

Generates ideas and options for products and processes

Builds and maintains core technical competencies

new products and ideas. The functional leader manages the R&D department, follows budgets and schedules for R&D projects, and ensures coordination between R&D and other departments in the organization. This is mostly primary team leadership but the last item is expeditionary and would fit into cell 1 in Table 2. In **Strategic Leadership** the main goal of the CTO is to integrate R&D strategy with corporate strategy. The CTO stays abreast of the evolving corporate strategy through interaction with other executives, and leads the co-evolution of R&D strategy. This integration of strategies is carried out mainly through interactions with people in the rest of the organization and ensures that the function of the primary team is on track. It therefore falls in cell 1. **Supra-functional Leadership** involves the formulation and execution of organizational strategy ensuring an appropriate role for technology. This goes beyond the traditional activities assumed for the leader of R&D. The CTO is actively involved in guiding the corporate strategy and the organization's strategic decision making process. The supra-functional leader manages innovations and ensures their application in other departments of the organization. The CTO also serves as an advisor to the CEO, specifically when acquiring new technology. This is expeditionary leadership fitting into cell 2 of Table 2. In overview, the three broad types of CTO leadership described by Uttal *et al* include primary team leadership and the facets of expeditionary leadership shown in cells 1 and 2 of Table 2. Cells 3 through 6 are not prominent here.

The entries for Uttal *et al* (1992) in Table 2 are not taken from the three broad theoretical leadership types just discussed, but from the list of specific activities of CTO's found in their empirical work and shown in Figure 1 on page 19 of their paper. With these specific activities we see entries in cells 1, 2 and 4 of Table 2, only one more cell than for the broad leadership types. Most of the entries involve expeditionary leadership with people in the rest of the organization and very few have to do with people outside the organization. The Uttal *et al* paper, with items in only half the cells of Table 2, suggests a not very comprehensive expeditionary leadership for the CTO.

Smith (2003) focused on the strategic relationships and responsibilities of the CTO, most of which fit into Table 2. Of the four items from Smith in the table, three involve interaction with people beyond the organization. This represents a complementary set to Uttal *et al* (1992) whose items clustered mainly with people in the rest of the organization. Smith also described the networking relationships that are important for the CTO. They include relationships with the CEO and executive committees, the CIO, chief scientists, research and development laboratories, and sales and marketing. Only two of these five relationships are centered in the technology function of the firm, reflecting the bias towards expeditionary leadership in the CTO's role. However, this list of relationships has little place for people beyond the CTO's organization, a bias shared with the Uttal *et al* (1992) paper.

Jonash (1996) addresses the CTO's role in the strategic outsourcing of technology and the activities he listed are entered into Table 2. He mentions mainly expeditionary leadership saying very little about primary team leadership. Surprisingly, most of the entries in Table 2 have to do with expeditionary leadership in the rest of the organization with only one in the beyond the organization category. Is this because Jonash's research validly shows little activity by CTO's beyond the organization even when alliances and outsourcing are involved? Or does this reflect a bias in his analysis? Does external technology sourcing get established without much external activity by the CTO? This seems unlikely. The source of this surprising outcome in Jonash's analysis needs further empirical research.

The entries in Table 2 include the unedited contributions from the several papers indicated. These contributions were edited and amalgamated to provide a more manageable presentation of the contents. The results of this are shown in Table 4. In Table 4 the phrase “Functions of the Technology Function” has been substituted for “Functions Assigned to the Primary Team” to reflect that the CTO’s primary team is the technology function.

Discussion and Conclusions

The framework of Tables 2 and 4 provides a set of activities which, theoretically, the CTO might become involved in as an expeditionary leader. The entries from the literature suggest the degree to which CTO’s actually exercise the different kinds of leadership. Cell 2 has the most entries. It involves the CTO in the expeditionary leadership of people in the rest of the organization on issues set in the rest of the organization. As seen in Table 4, many of these items involve technology and it could be argued that such items belong in cell 1, devoted to issues of the R&D function. They were not put in cell 1 because the items, as presented in the literature, are set in the context of organizations for which technology commercialization is a preponderant part of their business activity. In such companies technology issues are firm level issues (Uttal *et al*, 1992). All the items in cell 2 were chosen to reflect this. Cell 2 has more entries than cell 1 and cell 4, both of which involve expeditionary leadership intended to affect the technology function directly. This pattern supports those who have argued that the CTO has a leadership role to play for the organization as a whole and should not be confined to leading and taking care of the needs of the technology function. This empirical support for the argument suggests that the roles of the CTO beyond the primary team are under researched and are deserving of more empirical attention.

In recent years much attention has been given to the external acquisition of technology and other kinds of open innovation (e.g. Chesbrough, 2003; Jonash, 1996) and this implies that there should be considerable activity for the CTO beyond the organization. This does not seem to be the case in Table 4. There are several entries in cell 4 which is for expeditionary leadership beyond the organization on functions assigned to the technology function, but apart from that there is very little activity. There is only one entry for cell 5 (beyond the organization for functions of the organization as a whole) and that involves marketing and media relations for technology oriented products. Are there no other external

Table 4

Summary of CTO Expeditionary Leadership Activities Identified in the Literature Based on Table 2

Cell 1: Expeditionary Leadership in the Rest of the Organization, Functions of the Technology Function

Align R&D strategy with corporate strategy
Develop smoothly functioning interfaces between R&D and other organizational functions
Develop smoothly functioning interfaces among the different R&D units in the firm

Cell 2: Expeditionary Leadership in the Rest of the Organization, Functions of the Organization as a Whole

Leads efforts to optimize the value of technology for the company
Educate top management and others of technology developments
Lead integration of technology strategy with corporate and business-level strategies

Lead in technology-heavy corporate decisions on make, collaborate, buy
Lead in technology-heavy corporate decisions on mergers, acquisitions and alliances
Drives cross-functional commercialization activities
Leadership in improving company operations through technology
Takes lead in responding to business unit emergencies involving technology
Leadership in setting company culture which appreciates the optimization of technology value

Cell 3: Expeditionary Leadership in the Rest of the Organization, Functions Beyond the Organization

No entries

Cell 4: Expeditionary Leadership beyond the Organization, Functions of the Technology Function

Monitor the technology environment outside the organization
Identify technological threats and opportunities
Identify, investigate promising technologies for the organization
Build external technology partnerships, including IP
Balance internal and external sourcing

Cell 5: Expeditionary Leadership beyond the Organization, Functions of the Organization as a Whole

Marketing and media relations

Cell 6: Expeditionary Leadership beyond the Organization, Functions Beyond the Organization

Professional service leadership on government, academic and professional bodies

activities for the CTO given current strategies of externalization? Perhaps most of these functions are managed by the CEO or other, less technology-oriented leaders. Finally, there is only one entry for functions beyond the organization, cells 3 and 6. The one entry has the CTO involved in government, academic and professional organizations as a professional and/or public service. Smith (2003) stresses the service aspect of such activities but also notes that the CTO's firm will receive benefits as well. It seems the CTO is little involved with expeditionary leadership whose beneficial results accrue to the environment beyond the organization. Again, it may be the CEO or others who take on these roles. Should CTO's become more involved in them to enhance their credibility as executive-level players?

It also becomes apparent when reviewing the items in Table 4 that many of the activities of the CTO have effects in more than one locus. For example, as just mentioned, leadership on government, academic and professional bodies can have effects on functions beyond the organization and on the CTO's organization specifically. In a similar vein, the item in cell 2, "Lead in integration of technology strategy with corporate and business-level strategy" serves primarily to advance the organization as a whole but also has significant effects on the technology function. In Tables 2 and 4 activities have been classified according to their primary purpose, but empirical research should be done to foster a better understanding of the subtleties of primary, secondary and even tertiary purposes.

This paper has made the *prima facie* case that the CTO acts as both a primary team and expeditionary leader. The expeditionary aspects of the CTO's role has been presaged by a number of papers, most prominently by Smith (2003), Giordan and Kossovsky (2004) and by Uttal *et al* (1992), although none of them has used the concept of expeditionary leader. The concept of the expeditionary leader, used in conjunction with a distinction among the loci where the effects of leadership are intended to occur, has been used to map out a conceptual space within which the role of the CTO can be analysed.

The analysis suggests that CTO's do have significant roles to play as expeditionary leaders and that at least some of them already do play those roles. Most of these activities involve the leadership of people in the rest of the organization with the intention of moving forward on functions assigned to the primary team and for the organization as a whole. There is some expeditionary leadership of people beyond the organization and this tends to be focused on the assignments of the technology function.

These conclusions are based upon the fitting of the extant literature into the conceptual structure of Tables 2 and 4. The existing literature has not been guided by that conceptual structure. As a result we cannot discern the degree to which this pattern of findings reflects the true state of CTO leadership practice, or the limitations in the approaches taken in earlier studies. It may be that because researchers were not specifically looking for activity in all the cells of Tables 2 and 4 they failed to take note of those in the cells they were not considering. Empirical research using this broader conceptual framework is therefore needed to determine the comprehensiveness of the findings to date. Some fundamental questions for that research are as follow.

1. When provided with the conceptual structure of Tables 2 and 4, will CTO's agree that it maps important facets of their leadership roles?
2. When provided with the conceptual structure of Tables 2 and 4, will CTO's provide more examples of activities in the cells that have few if any entries?
3. Will CTO's share a more-or-less common pattern of the activities in Tables 2 and 4, will there be more than one common pattern, or will no patterns emerge?
4. What is the relationship between the primary-team and expeditionary leadership activities of CTO's?

Research on expeditionary leadership promises to provide a new perspective on leadership in organizations, one that is more consistent with the actual roles that managers and executives play. This fresh perspective may be of particular value to practitioners who are clearly involved in both primary team and expeditionary leadership (Kotter, 1982; Mayo and Nohria, 2005). Unfortunately, here-to-fore they have not been provided with much empirical research on expeditionary leadership, or a conceptual framework which legitimizes and organizes the expeditionary side. Research on the issues for CTO's proposed here should help to rectify this situation.

References

- Ancona, D. G., & Caldwell, D. F., "Beyond Task and Maintenance," *Group & Organization Studies*, 13(4), (1988), 468-4494.
- Ancona, D. G., & Caldwell, D. F., "Bridging the Boundary: External Activity and Performance in Organizational Teams," *Administrative Science Quarterly*, 37, (1992), 634-665.
- Arendt, L. A., Priem, R. L., & Ndofor, H. A., "A CEO-advisor Model of Strategic Decision Making," *Journal of Management*, 31(5), (2005), 680-699.
- Berson, Yair, & Linton, Jonathan D., "An Examination of the Relationships between Leadership Style, Quality and Employee Satisfaction in R&D versus Administrative Environments," *R&D Management*, 35(1), (2005), 51-60.
- Bridenbaugh, Peter. "Credibility between CEO and CTO - a CTO's perspective", *Research Technology Management*, 35(6), (1992), 27-33.
- Balkundi, P., & Kilduff, M., "The Ties that Lead: A Social Network Approach to Leadership," *The Leadership Quarterly*, 17, (2006), 419-439.

- Barbuto, J. E., & Moss, J. A., "Dispositional Effects in Intra-Organizational Influence Tactics: A Meta-Analytic Review," *Journal of Leadership and Organizational Studies*, 12(3), (2006), 30-52.
- Baron, R. A., "Opportunity Recognition as Pattern Recognition: How Entrepreneurs 'Connect the Dots' to Identify New Business Opportunities," *Academy of Management Perspectives*, 20(1), (2006), 104-119.
- Baum, J. R., Locke, E. A., & Kirkpatrick, S. A., "A longitudinal Study of the Relation of Vision and Vision Communication to Venture Growth in Entrepreneurial Firms," *Journal of Applied Psychology*, 83(1), (1998), 43-54.
- Broadbent, M., & Kitzis, E. S., *The New CIO Leader*, Boston MA: Harvard Business School Press, 2005.
- Carmeli, A., & Schaubroeck, J., "Top Management Team Behavioral Integration, Decision Quality, and Organization Decline," *The Leadership Quarterly*, 17, (2006), 441-453.
- Chesbrough, H. W., *Open Innovation* Boston MA: Harvard Business School Press, 2003.
- Dutton, J. E., Ashford, S. J., O'Neill, R. M., Hayes, E., & Wierbra, E. E., "Reading the Wind: How Middle Managers Assess the Context for Selling Issues to Top Managers," *Strategic Management Journal*, 18(5), (1997), 407-425.
- Dutton, J. E., Ashford, S. J., O'Neill, R. M., & Lawrence, K. A., "Moves that Matter: Issue Selling and Organizational Change," *Academy of Management Journal*, 44(4), (2001), 716-736.
- Elenkov, D. S., Judge, W., & Wright, P., "Strategic Leadership and Executive Innovation Influence: An International Multi-Cluster Comparative Study," *Strategic Management Journal*, 26, (2005), 665-682.
- Elkins, Teri, & Keller, Robert T., "Leadership in Research and Development Organizations: A Literature Review and Conceptual Framework," *The Leadership Quarterly*, 14, (2003), 587-606.
- Finkelstein, S. & Hambrick, D. C., *Strategic Leadership: Top Executives and their Effects on Organizations*. St. Paul, MN: West Publishing, 1996.
- Floyd, S. W., & Wooldridge, B., "Middle Management Involvement in Strategy and Its Association with Strategic Type: A Research Note," *Strategic Management Journal*, 13, (1992), 153-167.
- Floyd, S. W., & Wooldridge, B., "Dinosaurs or Dynamos? Recognizing Middle Management's Strategic Role," *Academy of Management Executive*, 8(4), (1994), 47-57.
- Floyd, S. W., & Wooldridge, B., *Building Strategy from the Middle*, Thousand Oaks, CA: Sage Publications Inc., 2000.
- Garg, V. K., Walters, B. A., & Priem, R. L., "Chief Executive Scanning Emphases, Environmental Dynamism and Manufacturing Firm Performance," *Strategic Management Journal*, 24, (2003), 725-744.
- Giordan, Judith C., & Kossovsky, Nir, "It's Time to Think Differently about R&D Assets and The CTO's Role", *Research Technology Management*, 47 (1), (2004), 9-12.
- Gwynne, Peter, "The CTO as Line Manager". *Research Technology Management*, 39 (2), (1996), 14-18.
- Harris, Richer C., & Lambert, Jean Truscott. "Building Effective R&D Teams: The Senior Manager's Role", *Research Technology Management*, 41(5), (1998), 28-35.
- Hirst, Giles & Mann, Leon, "A Model of R&D Leadership and Team Communication: The Relationship with Project Performance," *R&D Management*, 34(2), (2004), 147-160.

- Howell, J. M., & Boies, K., "Champions of Technological Innovation: The Influence of Contextual Knowledge, Role Orientation, Idea Generation, and Idea Promotion on Champion Emergence," *The Leadership Quarterly*, 15, (2004), 123-143.
- Jonash, R. S., "Strategic Technology Leveraging: Making Outsourcing Work for You," *Research Technology Management*, 39(2), (1996), 19-25.
- Kotter, J. P., *The General Managers*, New York: Free Press, 1982.
- Kraut, A. I., Pedigo, P. R., McKenna, D., & Dunnette, M. D., "The Role of the Manager: What's Really Important in Different Management Jobs. *Academy of Management Executive*, 19(4), (2005), 122-129.
- Larson, Charles F. "Critical Success Factors for R&D Leaders", *Research Technology Management*, 39 (6), (1996), 19-22.
- Markham, S. K., "Corporate Championing and Antagonism as Forms of Political Behavior: An R&D Perspective," *Organization Science*, 11(4), (2000), 429-447.
- Mayo, A. J., & Nohria, N., *In Their Time*, Boston MA: Harvard Business School Press, 2000.
- Medcof, J. W., "CTO Power," *Research Technology Management*, In Press.
- Mehra, A., Dixon, A. L., & Brass, D. J., "The Social Network Ties of Group Leaders: Implications for Group Performance and Leader Reputation," *Organization Science*, 17(1), (2006), 64-82.
- Mumford, Michael D., Scott, Ginamarie M., Gaddis, Blaine, & Strange, Jill M., "Leading Creative People: Orchestrating Expertise and relationships," *The Leadership Quarterly*, 13, (2002), 705-750.
- Mintzberg, H., *The Nature of Managerial Work*, New York: Harper & Rowe, 1973.
- Pajunem, K., "Stakeholder Influences on Organizational Survival," *Journal of Management Studies*, 43(6), (2006), 1261-1288.
- Preston, D. S., Karahanna, E., & Rowe, F., "Development of Shared Understanding between Chief Information Officer and Top Management Team in U.S. and French Organizations: A Cross-Cultural Comparison," *IEEE Transactions on Engineering Management*, 53(2), (2006), 191-206.
- Roberts, F., "Benchmarking Global Strategic Management of Technology," *Research Technology Management*, (2001), 25-36.
- Shim, D., & Lee, M., "Upward Influence Styles of R&D Project Leaders," *IEEE Transactions on Engineering Management*, 48(4), (2001), 394-413.
- Smaltz, D. H., Sambamurthy, V. & Agarwal, R., "The Antecedents of CIO Role Effectiveness in Organizations: An Empirical Study in the Healthcare Sector," *IEEE Transactions on Engineering Management*, 53(2), (2006), 207-222.
- Smith, Roger, "The Chief Technology Officer: Strategic Responsibilities and Relationships," *Research Technology Management*, 46 (4), (2003), 28-36.
- Tan, F. B., & Gallupe, R. B., "Aligning Business and Information Systems Thinking: A Cognitive Approach," *IEEE Transactions on Engineering Management*, 53(2), (2006), 223-237.
- Thamhain, Hans J., "Managing Innovative R&D Teams," *R&D Management*, 33(3), (2003), 297-311.
- Uttal, B., Kantrow, A, Linden, L. H., & Stock, S., "Building R&D Leadership and Credibility," *Research Technology Management*, 35(3), (1992), 15-24.