Bringing Theory into Practice: A Study of Effective Leadership at Lawrence Livermore National Laboratory

Anne Khoury
Lawrence Livermore National Laboratory

Leadership development, a component of HRD, is becoming an area of increasingly important practice for all organizations. When companies such as Lawrence Livermore National Laboratory rely on knowledge workers for success, leadership becomes even more important. This research paper tests the hypothesis that leadership credibility and the courage to lead are important contributors to leadership effectiveness, where leadership effectiveness is defined by Laboratory measures of effectiveness including performance appraisal, ranking, salary, and subordinate evaluation.

Keywords: Leadership Development, Credibility, Leadership

This study was designed to explore the relationship between "character" and effective leadership of the knowledge worker and was conceived from a desire to better understand how to develop effective leaders at Lawrence Livermore National Laboratory. Having worked in leadership development for a number of years, both in the public and private sectors and currently responsible for leadership development at the Lawrence Livermore National Laboratory, I wondered why our programs often failed to develop effective leaders. Our development programs improved skills and competencies and increased self-awareness. Yet, bottom-line business results did not necessarily improve over the long run and staff continued to report problems with management valuing and involving them in the work of the organization. This situation, I believed, was complicated when managers, such as those at the Laboratory, were leaders of knowledge workers. Leader-managers of knowledge workers are faced with the additional challenge of inspiring a workforce to shape company success by causing the talent they lead to generate the intellectual capital needed to achieve business results.

To cause a workforce to generate intellectual capital, more than learning about and applying leadership and management competencies seemed to me to be needed. I thought it was something implicit rather than explicit, and believed it to be leadership credibility and self-efficacy. This study focused on exploring this belief.

Background

The study hypothesized that the two "character" dimensions, leadership credibility and self-efficacy, were essential ingredients to effectively lead knowledge workers - one who turns aspiration into action to accomplish results for the organization. Both of these "character" dimensions have more to do with substance than with form; personal attributes rather than competency and skill. The leadership development programs at the Laboratory are currently focused on form (competency development), and have done little to enhance substance (personal attributes such as values, beliefs, belief in self).

The study was conducted at Lawrence Livermore National Laboratory located in Livermore, California, which is approximately 30 miles east of San Francisco. The Laboratory is a research and development institution with $1.6B dollar budget, run by the University of California for the Department of Energy's National Nuclear Security Administration. The Laboratory's mission is to ensure the safety and reliability of the U. S. nuclear weapons stockpile; to reduce threats to U. S. security; and to provide technical solutions to key energy, environment, infrastructure, and health security problems.

The Laboratory is a facility comprised primarily of knowledge workers who provide services that conform to Reich's (1994) definition of symbolic-analytic services, services that cannot be codified and controlled and services upon which the organization is dependent for competitive advantage. According to Reich, to perform symbolic-analytic services a college degree is usually required. The Laboratory workforce of 8650 individuals is comprised of scientists and engineers (40%), technical and crafts (22%), and administrative and clerical (22%) employees. Nearly half of the Laboratory scientists and engineers have a Ph. D. and another 30% have a master's degree. Of the remaining 20% of the scientific workforce, only one percent of the employees do not possess a college degree.

The Laboratory is organized into 13 directorates of which three discipline directorates (Chemistry & Materials Science, Engineering, and Computation) supply the majority of the scientific and engineering employees to four program directorates (Defense & Nuclear Technologies, National Ignition Facility Programs, Nonproliferation Arms Control & International Security, Homeland Security). Three directorates (Energy & Environment, Physics & Advanced Technologies, and Biology & Biotechnology), combine discipline and program direction authority. Three administrative and operations directorates provide support services for Laboratory operation. The study sample was selected from a mix of program and discipline directorates to ensure the sample represented leaders of knowledge workers, addressed generalizability to the extent feasible, and increased application use of the study's findings within the Laboratory.

Theoretical Framework

The focus of this study is on leadership not management. Management is about coping with complexity; leadership is about coping with change (Kotter, 1996). Leaders shape ideas rather than respond to them and develop new options rather than balance conflicting forces (Zaleznik, 1998).
Processes, products, and services are managed but a work force, particularly in knowledge organizations, must be led. Process improvements, reengineering, and restructuring can only take a company so far. To be successful in today's competitive and changing world, it takes ideas and innovation that come from the people or intellectual capital of the organization. When the work force in addition to processes, equipment, and facilities become central to success, leadership becomes paramount.

Although a variety of frameworks exist that explain leadership effectiveness, most theories can be classified into one of four traditions: trait, behavioral, and situational theories, and a set of emerging theories here labeled complexity theory. This study focused on behavioral aspects that enable effective leadership and related a set of behavioral and action factors to the underlying character dimensions – leadership credibility and self-efficacy – hypothesized as needed to demonstrate effective leadership. Leadership behaviors include creating vision, inspiring commitment, enabling and driving change, and developing and enabling others for success (Bass & Avolio, 1994; Kotter, 1996). To be able to accomplish these behaviors, leaders need to possess the ability to inspire action through the people they lead (Ulrich, 1996).

Credibility of action is a significant determinant of whether a leader will be followed over time (Kouzes & Posner, 1995). In a recent study of over 400 respondents from four continents (America, Asia, Europe, and Australia), Kouzes and Posner (1993) measured what actions exemplified quality leadership. The top four actions included characteristics of leadership credibility - honest, forward-looking, inspiring, and competent.

The ability of leaders to secure compliance with decisions is widely recognized as a central characteristic of leadership effectiveness (Tyler, 1990; Tyler & Lind, 1992). If leaders must continually explain and justify their decisions, their ability to lead is diminished. To lead the knowledge worker to accomplish business objectives, management becomes a social function in which relationships are key (Wheatley, 1992). It is this emphasis on relationship that elevates the primacy of personal attributes or the character of the leader into juxtaposition with leadership competencies.

Similarly, a person's dynamism and courage come from within and from a strong belief in a purpose and willingness to express that conviction. Bandura (1986) argued that whether or not people will undertake particular tasks or strive to meet particular goals depends on whether or not they believe they will be efficacious in performing the action. The stronger one's self-efficacy, the more one will exert effort and persist at a task.

In Paglis's (1999) study of managers' motivations for stepping forward to lead change, she proposes that the motivation to attempt leadership of change originates in a sense of leadership self-efficacy. An assumption of the study herein was that to be able to lead and inspire change, leaders must have the courage to lead and take risk. This demands a belief in one's self and the motivation to lead, often against hostile and challenging forces.

Methodology

The purpose of this study was to better understand the contribution of leadership credibility and self-efficacy to leadership effectiveness. To explore the relationship between leadership effectiveness and the study's two "character" dimensions, leadership credibility and self-efficacy, a survey research design and document review process was implemented. The Leadership Practices Inventory (LPI), developed by Kouzes and Posner (1997) with the addition of a study developed technical competence factor was used as the operational definition of leadership credibility and served as the first independent variable. The general self-efficacy subscale of the Self-Efficacy Survey designed by Scherer and Maddux (1982) and the Leadership Practices Inventory designed by Paglis (1999) defined self-efficacy,

and represented the second independent variable. Both were administered to a sample of Laboratory leader-managers. Because leadership credibility is an attribute, the LPI with the addition of the study developed technical competence factor was also administered to 3 to 5 subordinates of responding leader-managers.

To define leadership effectiveness, the following Lawrence Livermore National Laboratory measures of effectiveness were used:

1. FY2003 and FY2004 performance appraisal supervisor/management competency assessments – annual assessment of a manager-leader's level of competency on four factors (achieving results, leadership, workforce management, performance management), attributed by the supervisor.
2. FY2004 rank group – annual numerical assessment of a leader-manager's level of contribution to the organization, attributed by the supervisor and directorate management.
3. Target salary – to protect respondents' anonymity and to normalize salary across the research sample, target salary, rather than actual salary was selected for use. Salary is assigned to employees based on the level of worth the Laboratory, through the supervisory chain, attributes to each employee.

Additionally, four questions designed to assess leadership effectiveness on four factors (achieving results, leadership, workforce management, and performance management) were administered to at least three subordinate reports of the responding leader-managers. These four questions were those factor descriptors on the FY2003/FY2004 performance appraisal supervisor/management competency assessment, described above.

Prior to determining that these leadership effectiveness measures were appropriate for use, a definition and associated criteria of leadership effectiveness as applied to the knowledge worker was developed from the literature. The measurement instruments used by the Laboratory to determine leadership success were then analyzed, matched to the derived criteria, and selected for use.

This research design was selected in an attempt to operationalize leadership effectiveness through triangulation of data sources, by combining perceptions of subordinates and superiors on multiple instruments determined by Lawrence Livermore National Laboratory to be measures of effectiveness. Since "character" is an abstract concept, instruments that define and measure leadership credibility and self-efficacy were used rather than other research designs such as case study methods, for time and cost efficiency reasons. In addition, as little has been done to quantitatively measure the relationship between leadership character dimensions and leadership effectiveness, particularly on the self-efficacy dimension, methodology for replication was not readily available.

Survey questionnaires and document review were the data collection methods used in this study. Specifically, there were two E-survey questionnaires developed – one for the leader-manager sample and one for the subordinate report sample. The leader-manager E-survey contained two demographic questions – years in Laboratory management and years in management outside the Laboratory – and questions from three instruments, the Leadership Practices Inventory (LPI) with the addition of the study developed technical competence factor, the Self- Efficacy Scale and the Leadership Self-Efficacy Scale. The subordinate report E-survey questionnaire contained the LPI with the one study developed technical competence factor and the four performance appraisal questions measuring leadership effectiveness – achieving results, leadership, workforce management, and performance management.

The LPI, developed by Kouzes and Posner, defined leadership credibility by 5 factors – model the way, enable others, encourage the heart, challenge the process, and inspire a shared vision. At the Lawrence Livermore National Laboratory, technical competence is critical to success. Therefore to define leadership credibility for purposes of this study a technical competence factor was developed and used in addition to the Kouzes and Posner 5 LPI factors to measure leadership credibility.

To explore the relationship between leadership effectiveness and the two character dimensions, leadership credibility and self-efficacy, various data analysis strategies were used.

First, descriptive statistics of the sample were used to explore the extent to which leaders of knowledge workers at Lawrence Livermore National Laboratory exhibit leadership credibility and/or self-efficacy. Second, correlation analysis and measures of association were performed to determine the correlation among the various measurement instruments used in the study. Specifically, the correlations among the leadership credibility measures and the self-efficacy measures, whether general self-efficacy or leadership specific self-efficacy, were explored. Given the linear relationship between the self-efficacy measures, multiple-regression was also used to determine their relationship. Third, leadership effectiveness measure results were analyzed, combined, and used to determine high, medium, and low leadership effectiveness groups. Finally, each of the self-efficacy scales and the leadership credibility factors for both self and subordinate report were analyzed using ANOVA and discriminate function analysis (DFA) to determine whether or not they differentiated the high and low leadership effectiveness groups.

Results

Sample Characteristics

The leader-manager sample consisted of 118 leaders (project leaders to associate directors) out of 503 leader-managers (27% response rate) from five technical directorates at Lawrence Livermore National Laboratory - Engineering, Computation, Chemistry and Materials Sciences, Energy and Environment, and Defense and Nuclear Technologies. Given the study limitation of self-selection and the sensitive nature of the leadership effectiveness measures used, the 27% response rate for the leader-manager sample was not surprising. The leader-manager sample had nine years of Laboratory had nine years of Laboratory management experience (M = 8.98, SD = .60) and two years (M = 2.06, SD = .47) of management experience outside the Laboratory. The subordinate report sample consisted of 278 randomly selected employees, for a 45% response rate.

It was assumed that if a leader-manager did not perceive him/herself to be effective and credible, he or she would not allow access to sensitive performance data and subordinate assessment of his/her behaviors. To test this assumption, the sample was analyzed to explore the effectiveness, credibility, and self-efficacy of leader-manager participants.

As indicated in Table 1, the performance appraisal effectiveness rating attributed by supervisors showed that the leader-manager sample was rated as most effective on the *achieving results* (M = 8.79, SD = 1.58) and least effective on *performance management* (M = 7.67, SD = 1.857), on a ten point scale. Though slightly lower than the supervisor ratings on all four factors, subordinates rated their leader-managers' effectiveness highest on *achieving results* (M = 8.25, SD = 1.35) and lowest on *leadership* (M = 7.34, SD = 1.77), on a ten point scale. As indicated in Table 1, all but one of the four performance appraisal effectiveness ratings were in the eight point range out of a ten point scale, indicating that the leader-managers in the sample were generally evaluated as effective by their supervisors. Similarly, the data shown in Table 1 indicated that subordinates also generally evaluated their leader-managers as effective given that all four of the effectiveness ratings were in the seven to eight point ranges, out of a ten point scale.

Table 1. *Leadership Effectiveness Descriptive Statistics (N = 118 leader-managers)*

Variable	Minimum	Maximum	M	SD
FY04 Rank Group	1	5	1.56	.805
PA – Achieving Results	4	10	8.79	1.589
PA – Leadership	4	10	8.35	1.711
PA – Workforce Management	4	10	8.07	1.761
PA – Performance Management	4	10	7.67	1.857
Subordinate – Achieving Results	3.5	10	8.25	1.347
Subordinate – Leadership	1.5	10	7.34	1.77
Subordinate – Workforce Management	2	10	8.17	1.67
Subordinate – Performance	2	10	7.68	1.392
Target Salary	$6557/mo.	$22292/mo.	$12123/mo.	$2617/mo.

As indicated in Table 2, the highest rated leadership credibility factor for the leader-manager sample was *technical competence* as determined by both self (M = 8.92, SD = 1.02) and subordinate report (M = 8.57, SD = 1.47) using a ten point scale. *Inspire a shared vision* was the lowest leadership credibility rating for the leader-manager sample for both self (M = 7.53, SD = 1.56) and subordinate report (M = 6.66, SD = 1.62). The second lowest leadership credibility factor according to self (M = 7.94, SD = 1.05) and subordinate report (M = 7.20, SD = 1.53) was *challenge the process.*

A comparison of leadership credibility self-ratings and subordinate ratings for the leader-manager sample in Table 2, indicated that while subordinate ratings of their leader-managers were generally lower than were the leader-managers' self-reports, both were in the same direction. This finding is similar to that reported by Kouzes and Posner (2000) in which they found LPI other report data to be generally lower than LPI self report data, but to reflect the same factor relationships regardless of industry studied.

Comparing the self and subordinate report leadership credibility ratings exhibited in Table 2 to the percentile self and other report rankings in the Kouzes and Posner (1997) database of more than 12,000 leaders and 70,000 observers, the leader-manager sample was found to rank in the medium to medium low range of leadership credibility according to

subordinate report and in the high medium to low high range of leadership credibility according to self report. This means that the sample could be generally described as having a medium level of leadership credibility compared to LPI benchmark data.

Table 3 illustrates that the leader-manager sample scored themselves higher on the general self-efficacy scale than they scored themselves on the three leadership specific self-efficacy scale factors. Of the three leadership specific self-efficacy factors, *obtaining commitment* was the highest scored factor, *setting direction* second, and *overcoming obstacles* third, with all of these scores being reported in the upper quartile range, over 75%. This indicates that the leader-manager sample can be described as having a medium to high degree of self-efficacy, especially on the general self-efficacy dimension. It also points to data and analysis issue due to restriction of range of sample responses.

Table 2. Leadership Credibility Descriptive Statistics (N - = 118 leader-managers)

Variable	*Minimum*	*Maximum*	*M*	*SD*
Self-Challenge	5.17	10.00	7.94	1.05
Self-Vision	2.33	10.00	7.53	1.56
Self-Enable	6.80	10.00	8.86	.69
Self-Model	6.17	10.00	8.48	.78
Self-Encourage	4.70	10.00	8.01	1.39
Self-Competence	6.00	10.00	8.92	1.02
Subordinate-Challenge	1.00	9.38	7.20	1.53
Subordinate-Vision	1.00	9.83	6.66	1.62
Subordinate-Enable	3.00	10.00	8.19	2.45
Subordinate-Model	2.83	9.75	7.88	1.28
Subordinate-Encourage	1.75	9.58	7.47	1.47
Subordinate-Competence	2.50	10.00	8.66	1.75

Table 3. *Self-Efficacy Descriptive Statistics (N = 118 leader-managers)*

Variable	*Minimum*	*Maximum*	*M*	*SD*
General Self-Efficacy	3.88	7.00	5.97*	.55
LSE – Commitment	52.50	100.00	82.12	10.76
LSE – Direction	20.00	100.00	79.25	13.06
LSE – Obstacles	32.50	100.00	76.99	12.18

Note. General Self-Efficacy was assessed on a seven point scale. Leadership Specific Self-Efficacy was assessed on a 100 point scale.
*85.21 if reported on a 100 point scale.

In sum, the leader-manager sample was found to be generally effective, credible, and efficacious particularly on the achieving results (effectiveness), technical competence (credibility), and belief in ability to obtain commitment (self-efficacy) dimensions.

High, Medium, and Low Leadership Effectiveness Groups

The central premise of this research was that effective leader-managers of knowledge would be those with higher leadership credibility and self-efficacy than their less effective leader-manager counterparts. When high, medium, and low leadership effectiveness groups were compared, effective leaders where found to exhibit higher leadership credibility scores, on the leadership credibility factors, e*nable others*, *model the way*, and *encourage the heart*, when subordinate reports were the source of the leadership credibility rating. Using Wilks's multivariate criteria (Λ), Table 4 shows that these three factors, *model the way*, *enable others*, and *encourage the heart*, explained 34.75% of the mean variances between the High, Medium, and Low leadership effectiveness groups. Interestingly, it was the, *model the way* factor that represented 17.4% of this variance.[1] This indicated that the most effective leaders at the Lawrence Livermore Laboratory established standards and values and then set the example for others to follow. The fact that it was the *enabling others* and *encouraging the heart* leadership credibility factors that also exemplified the most effective leader-managers, indicates that the standards and values modeled by these leader-managers were those based on being honest and trustworthy and respecting and supporting others.

[1] *Model the way* is defined by Kouzes and Posner (1997) to be – "establishing values about how constituents, colleagues, and customers ought to be treated, creating standards of excellence and then setting the example, and following through on promises and commitments" (p. 71).

Table 4. *Discriminate Function Analysis Tests for Equality of Group Means (N = 118 leader-managers)*

	Λ	F	df1	p
General Self-Efficacy	.977	1.009	2	.369
Self-Report Challenge	.994	.234	2	.792
Self-Report Vision	.990	.442	2	.644
Self-Report Enable	.948	2.284	2	.108
Self-Report Model	1. 000	. 015	2	. 985
Self-Report Encourage	.983	.725	2	.488
Self-Report Competence	.973	1.145	2	.323
Leadership Specific Self-Efficacy - Direction	1.000	.008	2	.992
Leadership Specific Self-Efficacy - Commitment	.983	.721	2	.489
Leadership Specific Self-Efficacy - Obstacles	.998	.075	2	.928
Subordinate Challenge	.970	1.291	2	.280
Subordinate Vision	.969	1.346	2	.266
Subordinate Enable	.908	4.246	2	.018
Subordinate Model	.826	8.846	2	.000
Subordinate Encourage	.919	3.689	2	.029
Subordinate Competence	.981	.824	2	.442

When subordinate assessment was the only factor considered to determine high, medium, and low leadership effectiveness groups, all subordinate reported leadership credibility factors – *challenge the process*, *enable others*, *model the way*, *encourage the heart, inspire a shared vision*, and *technical competence* - significantly differentiated the high from the low leadership effectiveness group. Here 63.6% of the variance in the first discriminate function was primarily explained by these subordinate attributed leadership credibility factors – *challenge* (.835), *enable* (.813), *model* (.813), *encourage* (.749), *technical competence* (.488), and *vision* (.360). In other words, all factors of leadership credibility measured by the Leadership Practice Inventory (LPI) and the study developed technical competence factor were significantly related to leadership effectiveness when both leadership credibility and leadership effectiveness were measured by subordinate report. These findings confirmed the relationship Posner and Kouzes (1988) found between subordinate leadership effectiveness measures and the five leadership practices measured by the LPI.

The two control variables, degree level and years in management, were not found to differentiate the high, medium, and low leadership effectiveness groups, indicating that these two assumed confounds did not influence the major study finding that leadership effectiveness is related to attributed leadership credibility. Of interest is the fact that all three of the leadership effectiveness groups had an average of a master's degree and an average of 9 years of management experience. In other words, the sample was generally comprised of well educated, experienced managers and these characteristics did not change when membership in high, medium, or low leadership effectiveness groups was considered.

Discussion

What was particularly interesting was the fact that only three of the six leadership credibility factors were found to account for the differentiation of the high- and low-leadership effectiveness groups when the sample studied were leader-managers of knowledge workers. This finding was not consistent with Kouzes' and Posner's work which found all five LPI factors to differentiate the most effective leaders; however, their research was not focused on knowledge workers. Because knowledge workers need a sense of meaning, the opportunity to create something of lasting value, and the recognition of authorship (Bolman & Deal, 2001), it was not surprising that this study's results indicated it was those leadership credibility factors that supported these motivations (*model the way*, *encourage the heart*, and *enable others*), that were found to characterize the most effective leaders at the Lawrence Livermore National Laboratory.
Similarly, since credibility is about how leaders earn the trust and confidence of their constituents, it is not surprising that the major credibility factors found to differentiate the most effective leaders at the Lawrence Livermore National Laboratory were those that involved trust and valuing of the workforces they lead. This is consistent with the research on organizational trust (Bennis, 1997; Jones and George, 1998; Levine, 2000; and Zand, 1992). In fact, in his case study research, Zand (1997) found that trust was the leader's key to achieving open communication and collaborative, committed action.

The finding that *modeling the way* was the leadership credibility factor that most strongly differentiated the high from the low leadership effectiveness groups was particularly interesting. While the literature postulates that follow

through with actions consistent with words is important to effective leadership, it is only now beginning to be studied through such instruments as the Management Behavior Climate Assessment (Sashkin and Levine, 2000), designed to measure organizational trust. The study's results indicated that there is a stronger link between the *modeling the way* factor and leadership effectiveness than any of the other leadership credibility factors measured. The strength of this relationship has not been found in the literature and the literature has not been focused on leader-managers of knowledge workers, indicating opportunity for future research.

When high, medium, and low leadership effectiveness groups were compared, self-efficacy, whether general or leadership specific, was not found to differentiate the leadership effectiveness groups. However, self-efficacy, both general and leadership specific were significantly and highly correlated with the leader-manager's self-perception of his/her ability to *inspire a shared vision (r=.601, p<.05)*, *challenge the process (r-.566, p<.05)*, and to *model the way*. (r=.652, p<.05) In other words, self-efficacy, both general and leadership specific, was significantly related to a leader's belief in his/her ability to be inspiring, take risk and succeed, and to set the example. This means that in developing effective leaders, self-efficacy is an important component.

Additionally, general self-efficacy and leadership specific self-efficacy were found to be significantly related with leadership specific self-efficacy explaining 56.5% of the variance in general self-efficacy. This confirmed that general and leadership specific self-efficacy were separate, but significantly related dimensions. Thus the need to measure both general and leadership specific self-efficacy dimensions in this study was supported and indicates opportunity for future research.

While little has been done to study the relationship between self-efficacy and leadership effectiveness, the fact that the study did not find a significant relationship between any of the leadership effectiveness criteria and the self-efficacy factors is surprising particularly given the recent work on emotional intelligence and indicates opportunity for future research. For example, Goleman, Boyatizis, and McKee (2002) found that self-confidence, a component of emotional intelligence, is essential for leaders to assume the risk of change; and, Paglis (1999) found a relationship between high leadership specific self-efficacy and a manager's willingness to engage in the leadership of change. Other studies of emotional intelligence have also found support for the relationship between emotional intelligence and effective leadership (Goleman, 1995; Goleman, Boyatizis, & McKee, 2002; and Weisinger, 1998).

Self-efficacy, like self-confidence, was assumed in this study to give the leader-manager the will and courage to lead against oftentimes challenging forces. The found correlations between the leadership credibility factors, *inspiring a shared vision*, *challenging the process*, and *modeling the way,* as previously discussed, indicate support for this assumption and direction for leadership development practice.

Conclusion and Next Steps for Practice

Ulrich in the forward to the Zenger and Folkman (2002) book, *The Extraordinary Leader*, wrote about the importance of character in leadership stating, "Everything about great leaders radiates from character." (p. ix). The study's purpose was to explore the relationship between leadership effectiveness and character using leader-managers of knowledge workers as the subject sample. Findings indicated that character, particularly those factors associated with honesty, setting the example, and valuing and strengthening others, were what set the most effective leader-managers apart from their peers. Technical competence and self-efficacy were found to be common characteristics of the study's knowledge worker sample as was a drive for results.

Who a leader-manager is, his/her substance, was found in this study to differentiate the "best" leader-managers at the Laboratory. By their character, leader-managers establish the environment in which knowledge workers contribute and grow. As found by Pfeiffer (2000), "Leaders of companies that experience smaller gaps between what they know and what they do (to turn knowledge into action), understand that . . . they create environments, reinforce norms, and help set expectations through what they do" (p. 261). In other words, as confirmed by this research study, they *model the way*.

The study's results also confirmed Ulrich's (1996) supposition that to create the "air" in which employees work, leaders have the personal characteristics that engender trust and commitment. The most effective leader-managers at the Laboratory were found to establish trusting relationships and strengthen others – they *enable others*; and, were found to be just, fair, sincere, and recognize contributions – they *encourage the heart*.

Study findings indicated that knowledge workers at the Laboratory want to be encouraged, believed in and lead by those they trust to inspire them to accomplish the goals and objectives of the organization. To cause a workforce to generate intellectual capital for the organization, the study's findings indicated that the leader-manager's "character" does make a difference.

To develop character, more than assessment and competency development is needed. A new model for leadership development is implied. Next steps for practice include the development of a leadership development model for

Lawrence Livermore National Laboratory based on the study's findings and linked to the Laboratory's talent management strategy. Such a model will imply re-alignment of HRD practice given the assumption that an integrated HR systems approach will be needed for model implementation.

References

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. New York: Prentice-Hall.

Bass, B. M. & Avolio, B. J. (1994). *Improving organizational effectiveness through transformational leadership*. Thousand Oaks, CA: Sage Publications.

Bennis, W. (1997, August). Cultivating creative genius. *Industry Week*, 49, 84–88.

Goleman, D., Boyatzis, R., & McKee, A. (2002). *Primal leadership: Realizing the power of emotional intelligence*. Boston, MA: Harvard Business School Press.

Goleman, D. (1995). *Emotional intelligence*. New York, NY: Bantam Books.

Jones, G. R. & George, J. M. (1998). The experience and evolution of trust: Implications for cooperation and teamwork. *The Academy of Management Review*, *23*(3), 531-546.

Kotter, J. P. (1996). *Leading change*. Boston: Harvard Business School Press.

Kouzes, J. M., Posner, B. Z. (1993). Credibility. San Francisco: Jossey-Bass Publishers.

Kouzes, J. M, Posner, B. Z. (1995). *The leadership challenge: How to keep getting extraordinary things done in organizations*. San Francisco: Jossey-Bass Publishers.

Kouzes, J. M., & Posner, B. Z. (1997). *Leadership practices inventory workbook*. San Francisco, CA: Jossey-Bass/Pfeiffer.

Kouzes, J. M., & Posner, B. Z. (June 2000). *Leadership practices inventory psychometric properties*. Retrieved September 5, 2004, from Jossey-Bass web site.

Levin, S. L. (1999). *Measuring organizational trust: Development of an instrument to measure organizational trust*. Unpublished doctoral dissertation, The George Washington University, Washington, D. C.

Paglis, L. L. (1999). *Searching for the wellspring of leading change: Leader self-efficacy in organizations*. Unpublished doctoral dissertation, Purdue University, Indiana.

Pfeffer, J., & Sutton, R. I. (2000). *The knowing-doing gap*. Boston, MA: Harvard Business School Press.

Posner, B. Z. & Kouzes, J. M. (1988). Development and validation of the leadership practices inventory. *Educational and Psychological Measurement*, *48*, 483–496.

Posner, B. Z., & Kouzes, J. M. (1988). Relating leadership and credibility. *Psychological Reports*, *63*, 527-530.

Sashkin, M, Levin & S. L. (2000). *Development of an instrument to measure organizational trust*. Unpublished manuscript, The George Washington University, Washington, D.C.

Scherer, M., & Maddux, J. E. (1982). The self-efficacy scale: Construction and validation. *Psychological Reports*, *51*, 663-671.

Tyler, T. R. (1990). *Why people obey the law*. New Haven, CT: Yale University Press.

Tyler, T. R., Lind E. A. (1992). A relational model of authority in groups. In M. Zanna (Ed.), *Advances in experimental social psychology*, (pp. 115-191). New York: Academic Press.

Ulrich, D. (1996). Credibility x capability. In The Drucker Foundation (Pub.), *The Leader of the Future* (pp. 209-219). San Francisco: Jossey-Bass Publishers.

Weisinger, H. (1998). *Emotional intelligence at work*. San Francisco: Jossey-Bass Publishers.

Wheatley, M. J. (1992). *Leadership and the new science*. San Francisco: Barrett-Koehler Publishers.

Zalesznik, A. (1998). Managers and leaders are they different? *Harvard Business Review on Leadership*.

Zand, D. E. (1997). *The leadership triad: Knowledge, trust and power*. New York, NY: Oxford University Press.