

ANALYSIS OF MANAGEMENT VS. TECHNICAL PERSONNEL PERCEPTIONS OF THE EFFECTIVENESS OF DoD 8570M MANDATED IA CERTIFICATION TRAINING

Peter J. Starland D.Sc. Capitol College

16 June 2014

Abstract

This qualitative case study examined the difference in management and technical personnel's perceptions of the effectiveness of DoD 8570 mandated Information Assurance (IA) certification training at a Department of Defense facility located on the west coast of the United States. The results indicated participants found DoD 8570 IA certification training to be of limited utility. Generally, participants recognized a need for personnel new to the IA workforce to learn baseline IA concepts, but felt the mandate did little to build an essential body of IA experts within the Department of Defense. The study revealed opportunities for the Department of Defense to adopt improved training practices that are more in line with organizational and stakeholder needs and thus more effective at creating an expert IA workforce. The current research provides impetus for future research relevant to the participating facility, the Department of Defense as a whole, and any organization looking to strengthen its IA workforce.

Keywords: DoD 8570, information assurance, certification training, evaluation, effectiveness

Introduction

People are the baseline of properly secured computing systems and networks. People require security awareness, literacy, training, and education in order to provide required protection of the confidentiality, integrity, and availability of critical systems (Maconachy, Schou, Ragsdale, & Welch, 2001). The 2011 Department of Defense (DoD) Strategy for Operating in Cyberspace stated people are the frontline of defense in sustaining superior cyber hygiene and reducing internal and external threats (DoD, 2011). Booz Allen Hamilton (BAH) (2009) also indicated there is a growing need for managerially and technically skilled individuals within the Information Assurance (IA) competency. Furthermore, the creation of new government regulations coupled with the ever-increasing number of technical threats has added to this need (Dodge, Toregas, & Hoffman, 2011). Department of Defense Directive (DoDD) 8570 (2007) mandated the training and certification of DoD associated IA workforce personnel. This mandate creates an inherent need to continually identify the effectiveness of certification training deemed important for the various DoD IA stakeholders, including management and technical personnel.

The effectiveness of certification training as a means of delivering retainable information that improves trainee performance on the job has prompted debate. Nikandrou, Brinia, and Bereri (2009) stated the ultimate goal of training should be to provide necessary skills to employees, which assist the organization in achieving its goals. The great monetary investment by organizations in employee training indicates a need to justify the effectiveness of training programs. Training is only effective when an employee can transfer the skills learned to their job.

Such training transfer issues generate importance for the investigation of the effectiveness of IA certifications for IA managers, the IA technical workforce, and associated stakeholders. White and Cook (2003) suggested information security management and technical personnel might perceive certification effectiveness differently. Additional concerns arise when certification and training are regulated and mandated. Research

indicated regulations, such as DoD 8570M, might have the effect of focusing management attention on achieving compliance rather than on demonstrating increased security (Institute for Information Infrastructure Protection (I3P), 2011). The I3P (2011) stated training workforce personnel to fulfill compliance requirements is conceptually different from training workforce personnel to confront evolving real-world security needs. When industries are heavily regulated, organizations should focus on aligning training compliance with cybersecurity needs.

Marshall, Cardon, Goette, and Goreva (2007) pointed to statements proposing certifications provide little theoretical background to students. While certification training may prove a student knows how, a college degree shows a student knows why. Bartlett (2002) conducted a study on employers' preferences concerning certifications and traditional academic degrees. The study revealed employers preferred relevant work experience over traditional education and traditional education over certifications. Wierschem, Zhang, and Johnston (2010), who further stated certifications could play a role in hiring decisions, iterated Bartlett's idea that education and work experience are more valued over certification training.

By analyzing the effectiveness IA management and IA technical personnel associate with DoD 8570M IA training, decision and policy makers may begin to recognize potential flaws in the current training systems and be able to identify needed modifications to ensure training effectiveness. Since DoD 8570M compliance concerns U.S. DoD and DoD contractor personnel, working with secured systems, this study focused on that general population. Extensive analysis was performed on literature relating to IA certification effectiveness and best practices for evaluating training programs (Starland, 2013). This research uncovered no peer-reviewed nor scholarly literature concerning the effectiveness of DoD 8570M mandated IA certification training. Therefore, this study will benefit the IA field by providing in-depth analysis of the potential difference in perception, between IA management and IA technical personnel, concerning the effectiveness of DoD 8570M mandated IA certification training.

Theoretical Framework

A theoretical framework for the research was designed around the Kirkpatrick and Kirkpatrick (2006) model of training evaluation. While various methods of training evaluation have been developed (Brinkerhoff, 1988; Bushnell, 1990; Galvin, 1983; & Parker, 1979), the literary research for this paper indicated the Kirkpatrick model is the most widely used and accepted method of training evaluation (Chen, Chaung, & Lin, 2011; Kumar, Narayana, & Sagar, 2012; Kumpikaite, 2007).

To understand what properties create effective certification training it is important to recognize methods of evaluating the learning and training processes. Kirkpatrick (1959; 1975; 1994) provided a widely recognized four-level evaluation model for assessing training programs. The four-level evaluation model includes investigating trainee reaction, learning, behavior, and results. Evaluation of reaction examines how the learner liked or disliked the learning process. The learning level assesses the knowledge and skills gained by the learner. Gauging behavior identifies how job performance changed. Results evaluation ascertains tangible results such as reduced cost, improved quality, efficiency, and increased production.

Criticisms of Kirkpatrick's (1994) model speak to the necessity of addressing corporate needs in training evaluation. Chyung (2008) and Brinkerhoff (2005) suggested training evaluation should be a holistic corporate process, which starts with pre-training assessment and end with post-training evaluations. Kirkpatrick, when revising his original four-level model, considered these criticisms. Kirkpatrick and

Kirkpatrick (2006) developed a new model for developing and evaluating training programs for effectiveness. This new model began with nine steps addressing the planning for and development of effective training and ended with a tenth step for evaluation of training effectiveness. The tenth step was based on the original Kirkpatrick (1994) four-level model. This reorganization of the Kirkpatrick model makes it a planning and evaluation tool, which is more valuable to organizations (Chyung, 2008).

Analyzing trainee's perception of training is another important aspect of measuring training effectiveness (Alliger, Tannenbaum, Bennet, Traver, & Shotland, 1997). Warr, Allan, and Birdi (1999) asserted employee enjoyment, perceived usefulness, and perceived difficulties with training are essential factors to consider when assessing training effectiveness. Furthermore, Steensma and Groeneveld (2010) stated while measuring employee reactions to training is the most commonly used form of training evaluation, as well as very important, the method is inefficient on its own. To be effective, training evaluation must also analyze the motivation of employees to be trained and the corporate learning environment. Kirkpatrick and Kirkpatrick's (2006) holistic ten-step model of training evaluation was used in this study to facilitate identification of an evaluation framework which assisted in ascertaining the associations between training, knowledge transfer, and better workplace performance resulting from DoD 8570M IA certification training.

Method

The research question directing this study was *what is the potential difference in perception between IA management and IA technical personnel concerning the effectiveness of DoD 8570M mandated IA certification training?* The research question was explored using ten interview questions based on the Kirkpatrick (2006) training evaluation framework. The questions focused on relevant research topics: organizational needs, improved work quality, subject content, improved skills, organizational value, satisfaction, motivation, level of experience, advantages, and overall perception. The intent of the interview questions was to guide discussion focused on themes relevant to the effectiveness of IA certification training. Five personnel were interviewed from each subgroup in a pilot study, and an additional 15 personnel from each subgroup were interviewed in the actual study. Consent was obtained from each participant and confidentiality was assured throughout the data collection and analysis processes.

The data analysis process included organizing data, coding data, developing descriptions and themes, representing the findings, interpreting data for meaning, and validating the findings. Transcribed data was organized into Microsoft® Word and Excel based on responses to interview questions. Codes were determined for emergent themes arising from interview responses and documented in the researcher's notes during the interview process. Coded data in Microsoft® Word and Excel was combined with manual examination techniques to ensure collected data was thoroughly evaluated. Coded data was analyzed based on emergent themes in order to interpret greater meaning from the collected data. The data was examined for patterns in participant perception of the effectiveness of DoD 8570M mandated IA certification training as well as analyzed for potential difference in perception between management and technical personnel. Saturation was achieved as no unusual or unique responses emerged during the interview process.

Findings and Interpretations

The findings of this study revealed ten highly relevant thematic categories based on participant responses to the interview questions. A comparison of IA management and IA technical personnel responses were made for each thematic category.

Theme 1: Perception of work quality improvement from DoD 8570 mandated IA certification training.

The study findings revealed most technical personnel believed DoD 8570 mandated IA certification training did not improve the quality of their work. The majority of technical personnel stated they already had the knowledge and experience prior to IA certification training (40%) and felt that IA certification training was too broad and general to be of utility (40%). Other relevant responses included: does not apply to the work performed (20%) and exposure to new and helpful concepts (13%).

The study findings further revealed most management personnel believed DoD 8570 mandated IA certification training did not improve the quality of their work. The majority of management personnel stated they already had the knowledge and experience prior to IA certification training (60%) and felt that IA certification training was too broad and general to be of utility (20%). Other relevant responses included: does not provide required IA skillset (13%) improves IA skills and abilities (13%), improves communications by providing a common lexicon (13%), and broadens perspective and exposure to IA concepts (13%). The findings show management and technical personnel agree that DoD 8570 mandated IA certification training did not improve the quality of their work.

Evaluation of the interview responses revealed a relationship between training being too broad and not applying to one's job. Several participants indicated the certification training was too overarching to be of utility to the work they perform on a daily basis. Personnel who already felt they had the required knowledge and experience prior to certification found little personal utility from the training. However, a small amount from both sub-groups (13%), stated DoD 8570 did provide helpful concepts, required skills, and a common language.

This difference in perception may have been due to the amount of experience members of each group had prior to obtaining DoD 8570 IA certification training. These findings may indicate DoD 8570 mandated IA certification training is not doing enough to provide the knowledge needed for most personnel and needs to focus more on specific IA job requirements. This finding is consistent with a recently released report. Fryer-Biggs (2013) identified a report from DoD and IA industry experts addressing concerns that IA workforce personnel are entering into IA jobs based on certifications that provide little to no job-specific experience or training. The Defense Science Board (DSB) (2013) claimed the current DoD IA workforce lacks the required IA experience, and there is a great need for education and training programs that provide in-depth and hands-on IA experience to create the IA experts the DoD needs.

Theme 2: The amount of IA experience and education one has determines the perceived utility from DoD 8570 IA certification training.

Based on the amount of previous IA experience and education one had prior to DoD 8570 IA certification training, most technical personnel (87%) indicated a negative perception of utility. Technical participants with no IA background did find DoD 8570 IA certification training helpful (13%). Furthermore, based on the amount of previous IA experience and education one had prior to DoD 8570 IA certification training, most management personnel (73%) indicated a negative perception of utility. Management participants with no IA management background did find DoD 8570 IA certification training helpful (13%). Thirteen percent of experienced management personnel did believe certification training provided utility.

The interview responses revealed a relationship between previous experiences and perceived utility of certification training. The findings show management and technical personnel had negative perceptions of DoD 8570 mandated IA certification training utility when they had previous experience and education. However, personnel with little to no IA experience or education did find certification training helpful. This may indicate certification training does provide valuable utility to inexperienced personnel. Kirkpatrick and Kirkpatrick (2006) stated employees have to be matched to the right training. This finding may indicate experienced and educated personnel have different training needs than those who are inexperienced. Inexperienced personnel may benefit from more hands-on real world training practices. The DSB (2013) calls for DoD IA workforce personnel to have a greater depth of experience to be effective. This initiative requires more hands-on and mission relevant training for IA workforce personnel (DSB, 2013).

Theme 3: The subject content of DoD 8570 mandated IA certification training determines perceived utility.

The study findings indicate technical personnel believe the subject content of IA certification training was not relevant to their job/duties (73%) and may be good for someone with no IA experience (53%). Other relevant responses included already had IA knowledge and experience (20%) and provides a common language (20%). Management personnel believe the subject content of IA certification training does not help create IA experts or a highly trained/qualified workforce (33%) is not specific to DoD operating environment (27%) and provides knowledge on too general of a level (27%). Other relevant responses included: provides good wide-breadth of knowledge (27%) and provides a common language (13%).

The interview responses indicate technical and management personnel agreed that the subject content of DoD 8570 IA certification training did not apply to their jobs in the DoD operating environment. Kirkpatrick and Kirkpatrick (2006) identified subject content determination as essential for effective training. Reid (2012) stated, to be effective, training should cover topic relevant to meeting organizational goals and objectives. Current training practices may need to be modified to be more in line with personnel duties and the DoD's mission and goals. The findings may indicate the current categories of DoD 8570 (IAM 1-3, IAT 1-3, etc.) insufficiently address the job duties within the IA discipline.

Theme 4: DoD 8570 certification categories appropriateness.

Technical employees believe the DoD 8570 category levels (IAM 1-3, IAT1-3) and required training need to be more tailored to DoD job duties (67%) and more granular for the various IA positions within the DoD (40%). Management employees believe the DoD 8570 category levels (IAM 1-3, IAT1-3, etc.) and required training need to be more tailored to DoD job duties (93%) and more granular for the various IA positions within the DoD (53%). One participant believed the categories were properly aligned to current DoD job duties (7%).

Management and technical personnel agreed that DoD 8570 IA certification training categories should be more tailored to DoD job duties and more granular for the various IA positions within the DoD. This finding is in agreement with Dodge et al. (2011) who stated IA training should have clearer objectives and be aligned more closely to specialized IA job duties. Furthermore, this finding was echoed by Fryer-Biggs (2013), who identified IA industry and DoD experts who call for the DoD 8570 job levels to be refined for the various job positions within the DoD.

Theme 5: The value of DoD 8570 IA certification training.

Technical personnel perceived DoD 8570 IA certification training fell short of improving knowledge and skills (80%) yet may please customers and project sponsors (27%). Other relevant responses included: provided IA knowledge (13%) and forced people to get training (7%). Management personnel believed DoD 8570 IA certification training shows potential customers you have a qualified workforce (73%) and think the mandate helps force people to go get trained (40%). Other relevant responses included does not provided IA knowledge (33%) and not worth the money invested (20%).

Management and technical personnel tend to disagree on this theme. Technical personnel believe training fell short of improving IA knowledge and skills. Management personnel believe DoD 8570 compliance is good for business because customers are convinced workforce certification correlates with qualification to perform IA duties. Certification regulations such as DoD 8570 have been shown to focus management attention on achieving compliance rather than actually improving required skills and abilities (I3P, 2011). The I3P (2011) stated management focus on IA certification compliance may provide a false sense of security to DoD stakeholders.

Theme 6: Satisfied with DoD 8570 mandated IA certification training.

The study findings indicate technical personnel were not satisfied with mandated IA certification training. Technical personnel believed instructors were teaching to the test (80%). Other relevant responses included: participant did self-study (13%) and received needed knowledge and information (13%). The study findings indicate management personnel were satisfied with mandated IA certification training. Management personnel stated they were self-taught (40%). Other relevant responses included: received needed knowledge and information (27%), instructor taught to pass the test (20%), and a combination of the receiving knowledge and taught to pass the test (13%).

The interview responses revealed that management and technical personnel differed on their satisfaction with DoD 8570 IA certification training. Technical personnel mostly believed instructors were teaching to the test. Management personnel were mostly self-taught because of time constraints and believed they absorbed the training material quite well. This management satisfaction rate may be due to not having an instructor teaching answers to the test as the technical personal experienced. Trainee reaction to training is closely tied to learning (Long, DuBios, & Faley, 2008). Kirkpatrick and Kirkpatrick (2006) stated while positive reaction to training may not ensure training transfer, negative reactions will almost certainly reduce the possibility of training transfer. To be effective, instructors must demonstrate a desire to teach the material (Kirkpatrick & Kirkpatrick, 2006) not teaching to the test answers. The technical participant's dissatisfaction with DoD 8570 IA certification training may therefore be attributed to poor instruction practices.

Theme 7: Motivated to obtain DoD 8570 mandated IA certification training.

Technical personnel claimed their primary motivation to obtain DoD 8570 mandated IA certification training was because it was required/mandatory (80%) and to keep their job (33%). Other relevant responses included: to gain knowledge (27%), it looks good on a resume (7%), helps career advancement (7%), and for the prestige of having the acronym behind their name (7%). Management personnel claimed their primary motivation to obtain DoD 8570 mandated IA certification training was because it was required/mandatory (80%) and status/prestige associated with certification (33%). Other relevant responses included: to keep job (20%), to diversify self (13%), to gain knowledge (13%), and to set an example for employees (13%).

The study findings revealed management and technical personnel had the same motivation to obtain DoD 8570 IA certification training. Both groups stated their motivation was because training was required and mandatory. Brant (2002) indicated the more motivated an employee is to learn the more effective the training will be. With only 27% of technical personnel and only 13% of management saying their motivation was to learn and gain knowledge, DoD 8570 mandated IA certification training might not be effective. This finding may indicate a need to change the learning culture within the DoD and develop training requirements more in line with employee motivations.

Theme 8: Work experience, traditional education, and certification training role in improving work quality.

Technical personnel perceived work experience provided the knowledge required to do their job (60%) or a combination of work experience and traditional education (27%). Other relevant responses included: traditional education alone (7%) and a combination of all three (7%). Management personnel perceived a combination of work experience and traditional education provided the knowledge required to do their job (47%) and work experience alone provided the knowledge required to do their job (40%). A small number of managers perceived a combination of all three provided the knowledge required to do their job (13%).

The findings show management and technical personnel agree work experience and traditional education do more to improve the quality of their work. There is a need to provide more hands on training that is actually related to the duties IA personal have within the DoD (Fryer-Biggs, 2013; Defense Science Board (DSB), 2013). Therefore, DoD 8570 mandated IA certification training might not be providing the necessary skillset required to create a competent IA workforce.

Theme 9: Retention of knowledge from DoD 8570 mandated IA certification training.

Technical personnel believe little knowledge was retained from DoD 8570 mandated IA certification training because the training did not apply to what they do (53%) and they only retained the information that related to their day-to-day duties (53%). Other relevant responses included: already had knowledge to do job (33%) and no relevant knowledge was retained because instructor was teaching how to pass the test (27%). Management personnel believe little knowledge was retained from DoD 8570 mandated IA certification training because they only retained the information that related to their day-to-day duties (60%) and the training did not apply to what they do (27%). Other relevant responses included: already had knowledge from experience (13%) and already had knowledge from education (7%).

Both management and technical personnel agreed little information was retained from DoD 8570 mandated IA certification training. Each group stated the training did not apply to their daily tasks. These finding further echo previous themes. Experts in the IA field also agree that IA training within the DoD needs to be more relevant to the work performed by individuals for the distinct IA job functions (Dodge et al., 2011; Fryer-Biggs, 2013; DSB, 2013). According to Kirkpatrick and Kirkpatrick (2006), training is not effective when it is not relevant to the organizational mission and goals.

Theme 10: Perception of DoD 8570 mandated IA certification training effectiveness.

Technical personnel perceived DoD 8570 was effective at providing general concepts/baseline knowledge/common language (100%) and felt DoD 8570 needs to do more to create an effective/qualified workforce (100%). Other relevant responses include: needs to apply more to DoD job duties (80%), need to better define job roles (60%), have more hands-on training (53%), more emphasis on education and work

experience (33%), and stop using commercial certification companies for training (13%). Management personnel perceived DoD 8570 was effective at providing general concepts/baseline knowledge/common language (87%) and feel DoD 8570 needs to do more to create an effective/qualified workforce (73%). Other relevant responses include: needs to apply more to DoD job duties (67%) and needs to include more hands-on training (60%).

The findings revealed technical and management personnel agreed that if the goal of DoD 8570 was to provide general baseline IA concepts then it was indeed successful. However, both groups also agreed that DoD 8570 mandated IA certification training was failing to create an effective workforce that was qualified to perform the required IA duties within the DoD. Kirkpatrick and Kirkpatrick (2006) stated a training program's effectiveness is determined by providing the skills trainees need to take back to their job and assist in meeting organizational goals. If the goal of the DoD is to have a highly qualified IA workforce who can defend the nation against increasing cyber threats, DoD 8570 may not be helping achieve that goal. If the goal of DoD 8570 was to provide a baseline IA knowledge and common language to the IA workforce, the mandate may not be effectively supporting the mission of the DoD as a whole.

Recommendations

Recommendations for the DoD include the development and implementation of an IA training program that supports the mission and goals of the DoD and their associated stakeholders. This new program should be more tailored to the various IA duties within the DoD community. There is a great need, within the DoD, to define all the IA roles, responsibilities, and the required training for each role, in order to develop training and education programs to enhance IA personnel skills. There is also a need for academia and the professional certification training communities to recognize the need for granularity, within the IA discipline, and develop more rigorous education and training programs to assist the mission and goals of the IA community. Training programs need to be more hands-on, providing IA personnel with valuable real world experience related to their specific duties.

While it is recognizably important to provide everyone in the IA community with a common IA understanding and lexicon, more initiative must be taken to improve IA workforce efficiency to confront the cyber threats facing our nation. A blanket mandate which is "a mile wide, and an inch deep", is insufficient to provide useful knowledge, skills, and abilities to IA personnel. Flexibility should be given to each command, agency, and manager to identify the gaps in personnel skills and provide training and education to those personnel who need improvements to be more effective. The cost associated with current mandated IA training could be better applied to providing specific training and education that meets organizational goals.

A change in culture is also required to assist in improving the IA workforce. Management should not be concerned with training from a marketing perspective. Certifications may provide opportunities for more business prospects, but when the focus is on obtaining certification and not on gaining knowledge and improving skills, the workforce's efficiency suffers. A change in motivation to obtain training and education is also required. Personnel in the IA community should not be mandated into obtaining training that they do not desire and that does not help them improve their skills. Managers need to work closely with their employees to determine the training that employees need and desire. A culture of continuous learning and improvement should be adopted within the DoD to create a community of IA experts and nurture workforce improvement.

Summary

The results of this study show management and technical personnel agree, for the most part, DoD mandated IA certification training is not as effective as it could or should be. The differences of perception were in the areas of value provided by certification training, satisfaction with training received, and the primary advantages of certification training. Both sub groups believe more should be done to provide job-specific training. The majority of participants believed the current mandated training provides an overall understanding of IA and a common language to the workforce, but falls short of creating the community of experts required by the Department of Defense.

Despite the discussed limitations, this study is significant in that it adds to the body of literature by examining the effectiveness of IA certification training, as specifically mandated by DoD 8570. The results of this study provide DoD leadership the opportunity to improve current IA training requirements. In particular, the results of this study provide information leadership can use to develop new IA training programs, which would directly align with DoD mission and goals.

With current efforts to reduce DoD spending (Ackerman, 2012; Boland, 2012; Fryer-Biggs, 2013), this study offers insight into maximizing the return on investment of training expenses for the DoD IA workforce. The research conducted for this study provides momentum for future research examining IA training effectiveness. Future research should include public and private sector initiatives to improve the IA workforce and additional analysis of the effectiveness of current education and training practices.

References

- Ackerman, R. K. (2012). As defense budgets decline, threats rise. *SIGNAL* 66(11). 63.
- Alliger, G. M., Tannebaum, S. I., Bennett, W., Traver, H., & Shotland, A. (1997). A meta-analysis of the relations among training criteria. *Personnel Psychology*, 50(2), 341-358. DOI: 10.1111/j.1744-6570.1997.tb00911.x
- Bartlett, K., (2002). *The Perceived Influence of Industry-Sponsored Credentials in the Information Technology Industry*. St. Paul, MN: University of Minnesota, National Research Center for Career and Technical Education.
- Boland, R. (2012). Budgets, security mean big changes. *SIGNAL*, 66(11). 63.
- Booz Allen Hamilton (BAH). (2009). Cyber in-security: Strengthening the federal cybersecurity workforce. Retrieved from: http://www.boozallen.com/media/file/CyberIn-Security_2009.pdf
- Brant, J. (2002). Whom shall we choose?: Some criteria for selecting teacher trainees. *Teaching Business & Economics*, 6(2), 44-44. Retrieved from <http://search.proquest.com/docview/231262396?accountid=44888>
- Brinkerhoff, R. O. (2005). The success case method: A strategic evaluation approach to increasing the value and effect of training. *Advances in Developing Human Resources*, 7(1), 86-101. doi: 10.1177/1523422304272172
- Bushnell S. D. (1990). Input process output: A model for evaluating training. *Training and Development Journal*, 44. 41-43.
- Chyung, S. Y. (2008). *Foundations of instructional performance technology*. Amherst, MA: HRD Press Inc.
- Department of Defense (DoD). (2007). Department of Defense Directive 8570.01. Retrieved from: <http://www.dtic.mil/whs/directives/corres/pdf/857001p.pdf>
- Department of Defense (DoD). (2011). DOD strategy for operating in cyberspace. Washington, DC: Department of Defense.
- Defense Science Board (DSB). (2013). Resilient military systems and the advanced cyber threat. Retrieved from: <http://www.acq.osd.mil/dsb/reports/ResilientMilitarySystems.CyberThreat.pdf>

- Dodge, R. C., Toregas, C., & Hoffman, L. (2011). Cybersecurity workforce development directions. Retrieved from: <http://www.cspri.seas.gwu.edu/Publications.%20Papers.%20and%20Research/Costis%20-%20Cybersecurity%20Workforce%20Development%20Directions.pdf>
- Fryer-Biggs, Z. (2013). Experts say DoD cyber workers untrained. Retrieved from: <http://www.marinecorpstimes.com/news/2013/02/dn-cyber-certification-021613/>
- Galvin, J. C. (1983). What trainers can learn from educators about evaluating management training. *Training and Development Journal*, 37, 52-57.
- Institute for Information Infrastructure Protection (I3P). (2011). Workforce development: Understanding the demand. Retrieved from: <http://www.thei3p.org/docs/publications/432.pdf>
- Kirkpatrick D. L. (1959). Techniques for evaluating training programs. *Journal of American Society of Training Directors*, 13(3), 21-26.
- Kirkpatrick, D. L. (1975). *Evaluating Training Programs*. Alexandria, VA: ASTD.
- Kirkpatrick, D. L. (1994). *Evaluating Training Programs*. San Francisco, CA: Berrett-Koehler Publishers, Inc.
- Kirkpatrick, D. L. (1996). Invited reaction: Reaction to Holton article. *Human Resource Development*, 7(1), 23-25. DOI: [10.1002/hrdq.3920070104](https://doi.org/10.1002/hrdq.3920070104)
- Kirkpatrick, D. L., & Kirkpatrick, J. D. (2006). *Evaluating Training Programs: The Four Levels*, (3rd ed.). San Francisco, CA: Berrett-Koehler Publishers, Inc.
- Kumar, V. P., Narayana, M. S., & Sagar, M. V. (2012). Evaluation of training in organizations: A proposal for an integrated model. *International Journal of Engineering and Management Sciences*, 3(1), 77-84
- Kumpikaite, V. (2007). Human resources training evaluation. *Engineering Economics*, 5(55), 73.
- Lin, Y., Chen, S., & Chuang, H. (2011). The effect of organizational commitment on employee reactions to educational training: An evaluation using the Kirkpatrick four-level model. *International Journal of Management*, 28(3), 926-938.
- Long, L. K., DuBois, C. Z., & Faley, Robert, H. (2008). Online training: The value of capturing trainee reactions. *Journal of Workplace Learning*, 20(1), 21-37
- Maconachy, W. V., Schou, C. D., Ragsdale, D., & Welch, D. (2001). A model for information assurance: An integrated approach. Proceedings of the 2001 IEEE Workshop on Information Assurance and Security. West Point, NY: United States Military Academy.
- Marshall, B., Cardon, P., Goette, T., & Goreva, N. (2007). Finding the light at the end of the graduation tunnel. *Issues in Information Systems*, 8(1), 59-64.
- Nikandrou, I., Brinia, V., & Bereri, E. (2009). Trainee perceptions of training transfer: an empirical analysis. *Journal of European Industrial Training*, 33(3), 255-270.
- Parker, T. C. (1976). *Statistical Methods for Measuring Training Results*, in *Training and Development Handbook*. New York, NY: McGraw-Hill
- Reid Jr., D. A. (2012). Cyber sentries: Preparing defenders to win in a contested domain. Carlisle Barracks, PA: Army War College.
- Starland, P. (2013). *Analysis of Management and Technical Personnel Perceptions of the Effectiveness of DoD 8570M Mandated IA Certification Training: A Qualitative Case Study* (Unpublished doctoral dissertation). Capitol College, Laurel, MD.
- Steensman, H., & Groenveld, K. (2010). Evaluating a training using the “four levels model”. *Journal of Workplace Learning*, 22(5), 319-331.
- Warr, P., Allan, C., & Birdi, K. (1999). Predicting three levels of training outcomes. *Journal of Occupational and Organizational Psychology*, 72(3), 351-375. DOI: 10.1348/096317999166725
- White, G. L., & Cook, J. R. (2003). Vendor and professional certification: where is it headed? *Journal of International Technology and Information Management*, 12(2), 73-84.
- Wierschem, D., Zhang, G., & Johnston, C. R. (2010). Information technology certification value: An initial response from employers. *Journal of International Technology and Information Management*, 19(4), 89-IV.