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Adult learning: Barriers and enablers to advancement in Canadian power engineering

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Power engineering certification in Canada comprises a hierarchical, graduated system available to both young and adult learners. This paper offers insight into the knowledge gap regarding factors influencing Canadian power engineers' decision to pursue advanced certification in the Provinces of British Columbia and Alberta, with implications for adult learning in the power engineering sector of Canada. Comprehension of factors that influence intentions for power engineering certification may illuminate barriers and enablers to adult learning and provide evidentiary knowledge to support a format that facilitates advancement of certification. The research methodology was quantitative correlational design in which linear and logistic regressions employing a modified Bonferroni equivalent alpha were utilised. An original survey was developed for the study and pilot tested for validity and reliability. The sample comprised 1st, 2nd, and 3rd Class power engineers in British Columbia and Alberta. The dependent variable (DV) was the power engineers' advancement intention.

In the context of this paper, advancement intention is an influence leading to the inclination or reluctance to pursue promotion, succession, or advancement in employment. The independent variables (IVs) were time commitment, educational support, locus of control, time elapsed since previous certification, responsibility, and peer appraisal. Revealed in the results were positive, statistically significant relationships between the DV of advancement intention and three of the six IVs. Time commitment, responsibility, and elapsed time exert statistically significant effects on advancement intention (DV). The three remaining IVs that did not exhibit significant relationships with the DV were educational support, locus of control, and peer appraisal. This indicated that the IVs of educational support, locus of control, and peer appraisal did not significantly influence the DV when compared to the significant influences of time commitment, responsibility, and elapsed time on the DV. Comprehension of the influential factors regarding the intention of Canadian power engineers to pursue advanced certification may assist industry and academia with insight into the barriers and enablers to higher certification, and the correlation of decision factors with advancement intention.

Keywords: *Professional learning, adult education, Canadian power engineering, advancement.*

Introduction

Canadian power engineering certification ranges from Fourth (lowest) to First Class (highest). Fifth Class certification was not included in the study. Power engineers constitute an indispensable component of the labour force (The Institute of Power Engineers, 2017). Canadian government officials mandate formal academic and practical power engineering certification for individuals working with pressurised vessels, systems, and thermodynamic processes (Safety Authority, 2017). The quality of evaluation in learning scenarios incorporating practical (practice-based) learning is critical to achieving learning outcomes and conferring skills and knowledge (Logue, 2017). The opportunity to advance is a strong motivator for career-driven individuals, and this motivation requires stewardship to facilitate advancement. ‘Cognitive and motivational limitations exist for individuals and the constraints imposed upon their choices and actions within an organisation' (Scott, & Davis, 2007, p. 36). The personal negotiation process driving the advancement decision was central to the study. How an individual introspectively identifies with learning and the learning process influences academic goal achievement (Altmann, 2011). This introspection is an individual's subjective attitude or mindset towards learning. Anthropomorphically, the practical training component represents the skeleton and musculature of power engineering certification. The academic training component represents the brain and central nervous system of power engineering certification. The overarching power engineering program is the body, integrating the practical and academic elements. Power engineering offers education, training, and preparation extending from the operational to managerial, leadership, and business levels.

The general problem central to this study was lack of understanding of the factors that drive Canadian power engineers' decision to pursue advanced certification levels affecting the industry's ability to fill job openings in regulatory-mandated senior roles. Lack of power engineers in the managerial echelon (First and Second Class) impedes industrial progress in areas such as energy exploration, power generation, and manufacturing in Canada (Global News, 2017). The specific problem is that Canadian power engineers are not pursuing advanced certification needed to fulfill critical positions. For example, the distribution of power engineers in British Columbia is five per cent, 14 per cent, 30 per cent and five per cent for First, Second, Third, and Fourth-Class power engineers, respectively (BCSA-BTAC, 2017; Safety Authority, 2017).

Leaders and academicians require insight into factors inhibiting or inviting engineers to obtain higher level certification, and to gain perspective into the barriers and enablers to the academic and practical elements of adult engineering education. Contemporary approaches to adult learning include integration of work, home, and sociocultural environments with the objective of developing critical thinking and problem-solving skills, and to augment self-awareness (Allen, & Withey, 2017; Logue, 2017). The purpose of this study was to explore the presence of relationships between the IVs (time commitment, educational support, locus of control, time elapsed since previous certification, responsibility, and peer appraisal) and the DV (advancement intention). Understanding these relationships may assist in implementing measures that will reduce specific labour shortages in Canada's Power and Energy industries. In Canada, for the period of 2011–2020, power engineering related job openings derivative of expansion and replacement demands are projected to rise to 11,310 with only 8,109 job seekers available for these positions (Working in Canada, 2012).

Examined in this study were the influence of predominantly structural (time commitment, elapsed time, access to educational support) and predominantly humanistic (locus of control, responsibility, peer appraisal) decision factors (variables) upon the decision to advance. Structural or humanistic labels cannot be absolutely assigned to each variable, as they are not mutually exclusive and may coexist within a variable. However, for the purposes of this paper, the six IVs were assigned as either structural or humanistic. Identifying which factors were amenable to intervention may provide avenues to support advancement. Saar, Täht, and Roosalu (2014) similarly classified barriers (variables) to continuing adult education as situational (structural/humanistic), institutional (structural), and dispositional (structural/humanistic).

The study variables chosen were predicated upon the primary author's 20 years of direct experience as a power engineer, conversations and investigations during these years with a wide spectrum of industry and academic personnel, participation on power engineering, academic and technical advisory committees, higher-level education, and practical and academic exposure to the advancement process. Additionally, the identification of the study variables is rooted in Herzberg's Two-factor theory of motivators and hygiene factors (Hunter, 2012; Reif, 1975; Tuwei, Matelong, Boit, & Tallam, 2013; Yang, 2011) and supporting models including Maslow's hierarchy (Bille, 1978; Hunter, 2012; Johnson & Mortimer, 2011; Loscocco, 1989; Martin & Tuch, 1993), attribution theory (Ghonsooly & Shirvan, 2011; Jarvis, 2005; Weiner, 1979), and expectancy theory (Latane, Williams, & Harkins, 1979; Tyagi, 2010). For example, Herzberg's motivators and hygiene factors relate to the variables in this study, as motivators and hygiene factors may create the appropriate conditions for job satisfaction, or not detract from job satisfaction, as influences on the advancement decision.

The study was guided by the following research questions: What is the relationship between power engineers' intention to: (a) upgrade and the time commitment associated with First- or Second-Class certification? (b) upgrade and access to educational support for First or Second-Class certification? (c) upgrade and locus of control associated with First- or Second-Class certification? (d) upgrade and time elapsed since previous certification? (e) upgrade and the level of responsibility associated with First or Second-Class certification? (f) upgrade and peer appraisal associated with First or Second-Class certification? The null and alternative hypotheses reflect the research questions.

Power engineers ascending the class hierarchy face time commitment demands. The power engineer determines whether potential rewards associated with advancement warrant the additional time commitment to the workplace (Koubova, & Buchko, 2013). It is appropriate to assess work as a single constituent of life satisfaction, instead of the primary component in terms of life-work balance (Koubova, & Buchko, 2013). Relinquishing leisure or family time affects the family unit (Mubanga, & Nyanhete, 2013). Access to educational support is critical in self-directed learning and career advancement, while self-directed learners carried the most responsibility for deciding what was to be learned, and the method and rate of learning (Confessore, & Kops, 1998; Thurasamy, Lo, Amri, & Noor, 2011). Regardless of age, a gap (elapsed time) in academic study has implications for each individual (Znidarsic, 2012). How a student introspectively identifies with learning and the learning process influences academic goal achievement (Altmann, 2011). The individual considering upgrading after years of non-study is characterised as a mature learner, who must manage habits and behaviours embedded by experience (Willans, & Seary, 2011). The concept of responsibility is a subjective attribute of decision makers. Levels of responsibility untenable to one individual are manageable to another. The consequences of responsibility for the individual are not entirely positive (Hall, & Ferris, 2011). The manner in which their peers perceive and appraise others is a strong driver of behaviour, while fear of failure and accompanying judgment can eclipse the desire to advance, contingent upon the significance of the activity to the individual (Bélanger, Lafrenière, Vallerand, & Kruglanski, 2013).

The locus of control variable, while not identified in the analysis as statistically significant, is contextually relevant with the study variables.

An individual's locus of control orientation dictates how an individual perceives personal control over his/her life. Individuals possessing internal control loci accredit outcomes as consequences of personal actions (Igbeneghu, & Popoola, 2011). Individuals possessing an external locus of control assign outcomes to unmanageable phenomena such as luck, fate, or destiny (Igbeneghu & Popoola, 2011). Comparable studies in direct alignment with Canadian power engineering attraction/retention and advancement intention are few. Existing literature related to advancement intention and the six decision factors comprising each IV was available for consideration independently. Governing concepts were value system drivers including Herzberg's two-factor theory, Maslow's hierarchy of needs, locus of control, expectancy, prospect and attribution theories.

Method and design

A quantitative method was employed to collect and analyse numerical data using a five-point Likert-type ordinal-level survey as the data collection instrument. A survey instrument was appropriate for the quantification of subjective variables for correlational analysis. Likert-type scales are insensitive to linear transformation (Dobrovolny, & Fuentes, 2008). Quantitative studies provide a broader view of the phenomena under investigation (Hahs-Vaughn, & Lomax, 2013; Walker, & Madden, 2012). Statistical analysis comprised correlational analysis employing Spearman's rho, multiple linear regression (MLR) to generate multiple correlational values, and ordinal (ordered) logistic regression (OLR) using a modified Bonferroni equivalent alpha. Once Institutional Review Board (IRB) approval was secured, the survey instrument was pilot-tested antecedent to the main study data collection. The research design using Spearman's rho and MLR to generate correlations, followed with OLR to generate odds ratios, was appropriate to identify if the intent to upgrade fluctuates with decision factors. Spearman's rho tested the null hypotheses and determined if particular decision factors corresponded with advancement intention. Spearman's rho is a very commonly used correlative measure when analysing data that are not interval-level and assesses covariance between two variables (Hahs-Vaughn, & Lomax, 2013; Walker, & Madden, 2012). OLR is appropriate in cases where the DV is an ordinal variable, and when the researcher seeks to determine the extent to which one or more predictors affect this ordinal DV (Harrell, 2015; Hosmer, & Lemeshow, 2004; Orme, & Combs-Orme, 2009). The design aligned with study objectives of determining the presence or absence of correlations between advancement intention and decision factors influencing advancement intention. Study weaknesses may be related to the weaker non-probability convenience sampling method (Christensen, Johnson, & Turner, 2011), and a smaller sample size limiting the potential to detect true relationships among the study variables (Vogt, 2007).

Sample

The population consisted of Canadian certified power engineers working primarily in registered, First Class facilities (BC Power Engineer, 2013 in British Columbia and Alberta. The population of First, Second, and Third-Class engineers (Statistics Canada, 2011) was estimated at 4700. The total population figure is difficult to confirm since once an individual attains certification, it is seldom re-registered. The electronic survey link was emailed to each facility Chief Power Engineer who acted as the facility contact agent. The contact agent then emailed the link to all First, Second, and Third-Class Power Engineers at their facility. Chief Power Engineers are the ideal contact agents for distribution of the survey link to their power engineering employees. The Chief Engineer has direct control over power engineers at their respective facility and ensures that power engineers meet regulatory requirements. The Chief Power Engineers were asked to encourage survey participation. Initially, a target sample size of a minimum of 150 participants was approximated for the main study. The figure was established through incipient communication with the facility contact agents and a priori power analyses. A priori power analyses were conducted in G*Power 3.1.9.2 specifying a correlation and assuming a bivariate normal model was used.

A priori analyses are performed before a study is conducted as a method for determining sample size and controlling statistical power (Bredenkamp, 1969; Hager, 2006). Additional specifications consisted of a one-tailed test, an alpha of 0.05, a minimum statistical power of 0.80, a weak correlation of 0.2, along with a null hypothesis of zero correlation (Faul, Erdfelder, Lang, & Buchner, 2007). The results of the analysis indicated a minimum sample size of 153 in order to achieve a minimum statistical power of 0.80. The initial estimated attainable sample from the participating facilities was approximately 440. The survey generated 338 responses from the sample of 440, resulting in a 77% response rate. The 338 initial survey responses were reduced to 298 as a result of missing or incomplete responses. Many of the power engineer participants work on a shift schedule and have access to a common work computer terminal. While multiple users (employees) use the same terminal, each employee had a unique, personal email address. Survey Monkey software allows multiple responses from the same Internet Provider address. Consequently, the data collection tool was designed for ease of use in terms of multiple users on a single terminal, time management, and simplicity.

Instrument

A survey instrument was appropriate for the quantification of subjective variables for correlational analysis (Dobrovolny, & Fuentes, 2008), as the Likert-type scale is insensitive to linear transformation. Likert-type scale questions provide specific information. The researcher can sum the answers to the questions to get an overall rating, with composite rating scales tending to be more accurate than answers to single questions (Vogt, 2007). The survey was comprised of original questions plus validated, peer-reviewed locus of control survey questions (see Appendix A). An existing adaptable survey could not be located for use with the study. The original survey questions were conceptualised and adapted based on the research questions and hypotheses. The 23-question original survey contained one question for the DV of advancement intention. The IVs were represented by the following number of survey questions: (a) time commitment (4 questions); (b) educational support (4 questions); (c) locus of control (3 questions); (d) elapsed time (4 questions); (e) responsibility (3 questions); and (f) peer appraisal (4 questions) (see Appendix A).

Several validated peer-reviewed locus of control survey questions (Sapp, & Harrod, 1993), from an existing survey, were integrated with the original survey questions to form a single survey. The locus of control validated survey questions were added to properly address the locus of control variable in the context of the study. The original survey instrument generated for the power engineering study was tested for validity and reliability. Pilot testing consisted of construct validity testing via factor analysis, reliability testing (internal consistency) using Cronbach's alpha, and content validity testing using Lawshe's CVR (Kline, 2014; Lawshe, 1975; Yurdugul, 2008). Cronbach's alpha is a measure of internal consistency or scale reliability for the original survey instrument used in this study. Cronbach's alpha determined the extent to which the items in the survey are related. For the original survey, the Cronbach's alpha value exceeded the acceptable threshold of 0.7 (Nunnaly, & Bernstein, 1994).

The appropriate pilot study sample size for pilot testing the data collection instrument (survey) was determined via G*Power as with the main study. A priori power analysis indicated a sample size of approximately 30 for the pilot study. Pilot testing required three iterations, with 31 respondents per iteration, before establishing acceptable construct validity, reliability/internal consistency, and content validity. The result of the final pilot test indicated an acceptable factor structure for construct validity from the rotated component matrix of 0.803 to 0.913 (The importance of pilot studies, 2001). Cronbach's alpha values exceeded 0.7 on the third pilot test and were deemed acceptable (Yurdugul, 2008). The calculated Lawshe's CVR for the pilot study was 0.92, which exceeded the acceptable threshold value of 0.56 (Lawshe, 1975). Therefore, the survey instrument was deemed appropriate for use in the main study. Pilot study data were downloaded directly from the Survey Monkey database into a Statistical Product and Service Solutions (SPSS v24) data file and statistically analysed using SPSS software. The data for the pilot study were not included in the data used for the main study.

Data collection

Consistent with individual participant protections, collected data were treated as undifferentiated to protect organisational identity and unsolicited exposure. Data were collected in a non-interventional manner without manipulating the IVs or disturbing the population. The informed consent form was embedded in the electronic survey. Data was collected electronically via a survey link emailed to each facility Chief Engineer (contact agent). The contact agent then emailed the link to all First, Second, and Third-Class Power Engineers at their facility.

Analysis

Initially, Likert-type scale responses were coded from (strongly disagree = 1) to (strongly agree = 5). The coding was reversed to (strongly agree = 1) to (strongly disagree = 5) prior to uploading the data to the SPSS data file. The data were recoded with the reversed coding so that SPSS comparisons could be made with 'strongly disagree' as the base category. For OLR, SPSS makes comparisons with the highest coded (numbered) category as the base category. During data analysis Spearman's rho was used to evaluate the degree to which the relationship between two variables can be explained via a monotonic function. OLR was chosen to follow Spearman's rho to add methodological strength to the analysis. Spearman's rho served to test for the existence, magnitude, and direction of the relationship between two non-normally distributed measures, making this test an appropriate choice for the current study (Hahs-Vaughn, & Lomax, 2013). Ordinal-level measurement aligns with Likert-type scales and Spearman's rho, as well as OLR analysis. The summative benefit of following Spearman's rho with OLR methodology is that the impact of each IV on the DV is determined through OLR, while controlling for all other IVs included in the analysis (Harrell, 2015; Hosmer, & Lemeshow, 2004; Orme, & Combs-Orme, 2009). Following Spearman's rho and multiple regressions with OLR provides the researcher with correlation values and odds ratios as composite tools for investigation of research hypotheses.

A modified Bonferroni equivalent -□ of 0.0083 was calculated for this study to manage Type 1 error. Since numerous statistical tests were employed, a modified Bonferroni equivalent alpha was generated to account for cumulative error resulting from myriad tests. The objective of the modified Bonferroni adjustment was to make it difficult for a single test to be more statistically significant than another test (Jaccard, & Wan, 1996; Holland, & Copenhaver, 1988; Holm, 1979). As the Bonferroni equivalent -□ calculated for this study was 0.0083, for tests using the same database, the Bonferroni adjusted level of significance had to be less than or equal to 0.0083 in order to obtain statistical significance for any one test. A probability value of less than 0.0083 for a single test would be deemed statistically significant. Conversely, a test statistic would be deemed non-significant if it resulted in a probability value greater than 0.0083.

Results

Revealed in the results were positive and significant relationships between the DV of advancement intention and three of the six IVs. Time commitment, responsibility, and elapsed time exert a statistically significant effect on advancement intention. The IVs were initially analyzed with Spearman's rho as high-level screening criteria, prior to MLR and OLR, to determine if the IV should be included in a predictive model.

Positive and statistically significant relationships were observed between (i) *time commitment* [($r = 0.70$, $r^2 = 0.49$, $p < 0.001$)] / [Exp_B = 4.524 (95% CI, 3.129 to 6.542), Wald $\chi^2(1) = 64.357$, $p < 0.001$] and the DV, (ii) *responsibility* [($r = 0.52$, $r^2 = 0.27$, $p > 0.001$)] / [Exp_B = 2.471 (95% CI, 1.467 to 4.163), Wald $\chi^2(1) = 11.554$, $p = 0.001$] and the DV, and (iii) *time elapsed* [($r = 0.50$, $r^2 = 0.25$, $p < 0.001$)] / [Exp_B = 0.343 (95% CI, 0.226 to 0.521), Wald $\chi 2(1) = 25.178$, $p < 0.001$] and the DV.

Study findings failed to confirm the presence of statistically significant relationships between (i) *educational support* [($r = 0.41$, $r^2 = 0.17$, $p < 0.001$)] / [Exp_B = 0.851 (95% CI, 0.538 to 1.347), Wald $\chi^2(1) = 0.473$, $p = 0.492$], (ii) *locus of control* [($r = 0.18$, $r^2 = 0.03$, $p = 0.054$)] / [Exp_B = 0.732 (95% CI, 0.503 to 1.064), Wald $\chi^2(1) = 2.675$, $p = 0.102$], and (iii) *peer appraisal* [($r = 0.34$, $r^2 = 0.12$, $p > 0.001$)] / [Exp_B = 1.374 (95% CI, 0.827 to 2.284), Wald $\chi 2(1) = 1.503$, $p = 0.22$] and the DV.

Statistically significant results for time-based variables (time commitment and time elapsed) were anticipated and intuitive. Statistically significant results for responsibility, while intuitive, were less predictable as personal predispositions toward responsibility vary. The lack of a statistically significant effect for locus of control on the DV was surprising given the behavioural (introversion/extroversion) influences on decision-making.

Discussion

Canadian power engineering certification comprises both academic and practical components. The academic component is delivered via an educational institute and constitutes formal learning. The practical learning component is delivered in the workplace environment and encompasses field-based learning and exposure to processes, which may include pressurized vessels, systems, and thermodynamic operations. The practical component, while equally important, is less formalized than the academic portion of power engineering training and certification. Akinsooto and Akpomuje (2018) described four stages of informal learning: (a) tacit (socialization); (b) incidental (unintentional); (c) explicit (partially intentional); and (d) self-directed (fully intentional). Informal learning exists, in differing proportions, in both academic and practical learning processes. The power engineer pursuing certification through academic and practical avenues may move along the continuum from tacit to self-directed learning in the same subject matter area from both academic and practical perspectives. Focus on formal and informal learning processes is fundamental to acquiring knowledge in both academic and practical environments. The three IVs displayed significant relationships with the DV are time commitment, responsibility, and time elapsed.

Time commitment

The statistically significant value for time commitment (T-Average) at 5% level of significance (p = 0.001), was less than the modified Bonferroni equivalent alpha of 0.0083. Exp_B or the odds ratio indicates the likelihood of an event occurring. The Exp_B value of 4.524 indicated that an increase in time commitment is associated with power engineers being more committed to certification upgrade (advancement intention). For every one-unit increase on the five-point Likert-type scale response for time commitment, a 4.524-fold increase exists in the likelihood of committing to upgrading. If time commitment can be favourably influenced, commitment to upgrade can be theoretically influenced 4.524 times. Whether it is the estimate coefficients or Exp_B, when the variable is statistically significant, its estimates fall within the 95% confidence interval.

Responsibility

A statistically significant p-value (*Sig*) of 0.001 for responsibility was achieved and was less than the modified Bonferroni equivalent of 0.0083. The Exp_B (odds ratio) of 2.471 signified that a one unit increase in responsibility is associated with an increase in the odds of being likely to commit to certificate upgrade (advancement intention). Simply, for one (1) unit increase on the 5-point Likert-type scale response, a 2.471-fold increase exists in the likelihood of committing to upgrading. If responsibility can be framed favourably, commitment to upgrade can be theoretically influenced 2.471 times.

Time elapsed

A significant *p*-value (*Sig*) of < 0.001 for elapsed time was generated, which is less than the modified Bonferroni equivalent of .0083. The Exp_B value for elapsed time is 0.343. For elapsed time, the odds ratio multiplier approximates 0.31. An odds ratio of 0.31 (i.e., 69% decrease in the odds ratio), indicates a one unit increase in elapsed time is associated with a 69% decrease in the odds of being likely to commit to certificate upgrade (advancement intention). Note that the elapsed time variable, instinctively, has an inverse relationship with advancement intention. Positive responses to the survey question for this variable indicate elapsed time as an obstacle to certification advancement. To ameliorate the conceivable negative effect of elapsed time on advancement intention, mitigation strategies are required. Implementing incentives to encourage upgrading may minimise the adverse effects of elapsed time on advancement intention.

Conclusion

Time commitment

Intuitively, increasing time committed to a task (e.g. upgrading) will confer positive outcomes toward task completion. Increasing time committed to a task elevates the potential for task completion. Power engineers as adult learners (>18 years) deciding to pursue advanced certification, by implication, make the choice to increase their workload through the addition of time devoted to study and homework in a mass balance exercise. Time relinquished to one function must be subtracted from another function. Attitudes toward study and homework play a large role in academic achievement as students gain maturity and enter a self-regulated learning environment (Chang, Wall, Tare, Golonka, & Vatz, 2014). Once the decision is made to pursue higher certification, arming power engineers with information relevant to effective time management strategies is recommended to facilitate advancement. Effective learning requires objectives meaningful, actions designed to support the objectives, and effort expended to indicate achievement of these objectives (Macdougall, Epstein, & Highet, 2017).

Chang et al. (2014) reported a positive association between time committed to study and homework, and the potential for facilitating successful outcomes. These potentials include quality of instruction, academic motivation, and intellectual ability (see also Chang et al., 2014), as factors important in encouraging the pursuit and sustainment of the desire for additional learning. The results of the current study denoting the benefits of increasing time committed to class level upgrading are supported in the literature, though not directly in terms of the power engineering discipline. Time committed to homework and study extended the time to learn outside the classroom and enhanced academic learning possibly through priming the active cognitive processing and learning functions (Cooper, 1989, 2001; Mayer, 2011; Rawson, Stahovich, & Mayer, 2016). Engagement is the amount of time that a student commits to a task, and operates as a mechanism to influence learning outcomes, as indicated by achievement (Rawson et al., 2016).

Responsibility

An increased level of responsibility associated with the job role, whether real or perceived, has different implications for each individual. Responsibility is a subjective concept that cannot be unequivocally expressed through conversation or literature. Additional quantitative, qualitative, or mixed methods research may enhance comprehension of responsibility as a key construct in accordance with the specific research area under investigation. An individuals' affinity or repulsion for the challenge of responsibility must be learned and appreciated through practical experience and may either attract or deter the power engineer considering advancement. Creating attractive conditions surrounding job role responsibilities may attract the power engineer seeking greater challenges or encourage the power engineer who may be indecisive regarding upgrading. Job and career satisfaction tend to make employees enthusiastic in their work and provides a greater sense of responsibility (Kong, Cheung, & Zhang, 2010). The survey results indicated that responding affirmatively to statements framing responsibility favourably correlated with an affirmative response to seeking advanced certification.

The power engineer pursuing advanced certification, and potentially a senior position with greater responsibility, will consider methods of adapting and managing this responsibility. The individual may conform to the job role, reject the job role, shape or modify the job role, or within limits, create a more idiosyncratically acceptable role (Afiouni, & Karam, 2014). The astute manager or leader may assist to align entry into this role, within organisational limits, to suit an appropriate candidate in terms of role indoctrination and adapting to increased and changing demands (Afiouni, & Karam, 2014). As a recommendation, arranging probationary or trial periods in senior job roles accord the power engineer with exposure to new levels of responsibility. The probationary role ideally will provide the power engineer with job experience at a senior level, permits the employee to determine their suitability for the role, and allows managers to temporarily fill the position and examine specific candidates for the roles.

Time elapsed

The elapsed time variable, instinctively, has an inverse relationship with advancement intention. As the temporal gap between previously achieved certification and exposure to the study increases, presumably, advancement intention decreases. Cook (2010) cited that adult learners encountered different obstacles than full-time students in traditional academic environments. Elapsed time, or time passed, cannot be recovered. To ameliorate the conceivable negative effect of elapsed time on advancement intention, mitigation strategies are required. Implementing incentives to encourage upgrading may minimise the adverse effects of elapsed time on advancement intention. A similar inverse relationship was indicated in the literature review (Igbeneghu, & Popoola, 2011) between organisational commitment and the degree of an individual's predisposition to externality (external locus of control).

Incentives must serve joint objectives of both the power engineer and management. If management and the employee have divergent objectives, positive outcomes are unlikely. Will (2015) stated that the method for changing perceptions regarding negative influences (e.g.

elapsed time) might not be shared by both management and employees (see also Klein, & Sorra, 1996; Kotter, & Schlesinger, 2008; Lines, 2004; Rumelt, 1995; Zeffane, 1995). The initial step in encouraging the power engineer is to create the desire to upgrade, notwithstanding the temporal gap since prior certification or academic study. Management must work with employees to determine the type of incentives that may positively influence employee behaviour (Aisha, & Hardjomidjojo, 2013). Similar to the variables of time commitment and responsibility, creating an upgrading plan involving the power engineer and leadership may produce the ideal environment for a positive outcome.

The power engineer contemplating advancement after a lapse in time may have myriad motivations including enhancing their ability to compete in a knowledge-based environment (Ahmad, Abiddin, Badusah, & Pang, 2009: Lee, & Pang, 2014) or to fulfill the need to transfer effective learning skills to the workplace (see also Madsen, & Wilson, 2006; Nirodha, Amaratunga, & Haigh, 2014). The power engineer, as an adult learner, may also be confronted with obstacles involving weak study practices, adapting to technology, time management, and anxiety stemming from a changing environment. The variables in the current study were segregated into structural and humanistic components. Barriers and enablers to upgrading may also be separated into structural/humanistic or cognitive/physical constituents (Cook, 2010). A critical task for the power engineer, managers, leaders, and the educational institution is to evaluate the obstacles for each individual, prior to engaging with academic pursuits (Turcotte, 2015). Identifying and removing obstacles prior to certification upgrade may reduce anxiety for the power engineer and enhance confidence.

Locus of control

The locus of control variable, after analysis, did not indicate an acceptable correlation for inclusion in the predictive model. However, locus of control is a transitive variable with the potential to largely influence inherent decision-making processes and subsequently, more discreet decision components such as career path, educational pursuits, relationships, and leadership predispositions. The primary author's experience indicates that this variable has the potential to perceptively influence the other IVs in the study, through the transitive properties of personal control loci. Internal or external loci held by the participants may affect responses to survey questions probing time commitments, requirements for support, elapsed time since previous certification, responsibility assessments, and peer appraisal. Personality factors derivative of locus of control, such as introversion/extroversion and leader/follower orientation may relate to advancement intention.

In conclusion, advancement intention and decision variables such as time commitment, effect of lapses in times on study, educational support systems, moderating effects of responsibility, peer appraisal, and locus of control were studied. The results of the study provide sound evidence for the presence of significant relationships between the IVs of time commitment, responsibility, and elapsed time with the DV of advancement intention. The study was conducted in western Canada. However, the method employed, and the findings could be potentially applicable to the rest of Canada, as well as to other countries that exhibit similar power engineering advancement guidelines. The findings of the present study clearly include conditions that may enhance or facilitate advancement in power engineer class and conditions that may attract and/or retain power engineers. Potential exists for application of study findings in other fields requiring formal certification.

Investigated in the current study were the theoretical (academic) and practical (operational) elements of power engineering certification, and the power engineering archetype. The elements are pervasive and inherent to many career paths including information management, science-based study, and business. Preparation and training for power engineering encompasses quantitative aspects similar to the disciplines of hard science and qualitative aspects inherent to business, management, and leadership. The focus of the current study was to understand the bridging mechanisms required to enable both quantitative and qualitative aspects in the power engineer. The understanding is valuable for general preparation and career path development.

Canadian power engineering offers an attractive career path. The power engineering discipline integrates practical field-level work experience with rigorous academic study through a graduated and progressive certification hierarchy. Power engineering sets the foundation for advancement in industry and academia, in conjunction with the desires and needs of the power engineer. Training in power engineering accrues benefits for the individual, industry, and academia.

Limitations

Limitations may arise from the validity and reliability of the pilot study for the original survey. Employing 'combined' measures with OLR, rather than 'individual' measures, reduced the overall number of tests required in the analysis. Fewer tests assisted to manage Type 1 error, but when combining measures into a single measure for the purposes of analysis, reliability needs to be sufficiently high for this to be appropriate (Bland, & Altman, 1997). The results of the study were also limited by the number of participants available to participate in the survey. Wildfires in the Fort McMurray region (The Globe and Mail, 2016), and the lower commodity price for oil (Patterson, 2016; Low oil prices, 2015) adversely affected the facilities and the sample responses. As convenience sampling was used in the current study, any results obtained can only be applied to the sample analysed. To the extent that the characteristics of the convenience sample resembled or could be used to represent certified power engineers in other provinces, the results of the study can be important to interprovincial-certified, power engineering community. The generalisation of results found to the population from which the sample was derived, or any other population, would need to be tentative at best. The sample was limited to two Canadian provinces, with the results being less generalisable to other geographical areas. This paper provides a foundational quantitative platform for further power engineering research.

Recommendations for future research

Locus of control was considered in the current study as an influence on advancement intention. A future qualitative study with a focus on personal control loci may produce deeper and more meaningful results with a different sample. Locus of control predispositions are rarely polarised as fully internal or fully external. An internalised locus does not presuppose complete free will. An externalised locus does not presuppose a completely deterministic universe. Positions along the locus of control continuum represent individual perspectives, thought, values, needs, motivations, and situatedness. If the astute manager, leader, or academic can recognise these positional elements in an individual, they may leverage the attributes to support and develop the individual aspiring to succeed. Further research on locus of control in relation to decision-making is recommended. Loci of control factors are fertile areas for further academic investigation, perhaps through cross-sectional or longitudinal studies to investigate causation. Future research should also include similarly affected industries confronted with the challenge of recruiting 1st and 2nd Class Power Engineers, and an investigation of the cultures in affected organisations for similarities and differences.

Research regarding the joint management of change between stakeholders and principals involved in the change process is recommended. Changes are required to overcome barriers and enhance enablers to the upgrading process. In the current study, the stakeholders are power engineers, and industry and academic agents. Change requires postulating the problem, generating hypotheses, and testing for relationships between conjectural solutions and outcomes. Tucker, Hendy, & Barlow (2015) cited change theory as a predictive assumption regarding the relationship between desired changes and the actions that might affect the changes (see also Kezar, Gehrke, & Elrod, 2015). The stakeholders as change agents ideally work as a team, but with specifically identified roles for enabling an upgrading or advancement process. Tucker, Hendy and Barlow (2015) contended that facilitating change in healthcare organisations required clarity of role assignments in the change process. Role assignment is a determining factor for improving change management processes (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004). Research in the area of change agency may be generalisable to many areas in industry and academia, including power engineering. Change agency is a central aspect in the decision to pursue advancement certification. The power engineer, or adult learner, must remove obstacles to advancement through changing internal or external aspects of the learning process to facilitate advancement. The ability to manage change creates conditions for learning and advancement.

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