EXPLORING LEADERSHIP STYLES FOR INNOVATION: AN EXPLORATORY FACTOR ANALYSIS

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A B S T R A C T

Leadership plays a vital role in building the process, structures, and climate for an organisation to become innovative and to motivate team expectations toward innovations. This study explores the leadership styles that engineers regard as significant for innovation in the public sector. Exploratory factor analysis (EFA) was conducted to identify the principal leadership styles influencing innovation in the Australian Public Service (APS), using survey data extracted from the 2014 APS employee census comprising 3 125 engineering professionals in Commonwealth of Australia departments. EFA returned a two-factor structure explaining 77.6% of the variance of the leadership for innovation construct. In this study, the results from the EFA provided a clear estimation of the factor structure of the measures for leadership for innovation. From the results, the two factors extracted were transformational leadership and consideration leadership. In transformational leadership, a leader values organisational objectives, inspires subordinates to perform, and motivates followers beyond expected levels of work standards. Consideration leadership refers to the degree to which a leader shows concern and expressions of support for subordinates, takes care of their welfare, treats members as equals, and displays warmth and approachability. These findings highlight the role of leadership as the most critical predictor when considering the degree to which subordinates strive for creativity and innovation. Both transformational and consideration leadership styles are recommended to be incorporated into management training and development programs. This study also recommends that Commonwealth departments recruit supervisors who have both of these leadership styles before implementing innovative projects.

K E Y   W O R D S

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INTRODUCTION

In Australia, total government expenditure as a proportion of GDP is around 34%. Therefore, the public sector generates a sizable proportion of economic output and substantially more than the share of manufacturing in most countries (Arundel & Huber, 2013). Innovation in the public sector is of high policy interest as it has the potential to improve the efficiency and quality of government services (Moore & Hartley, 2008). Innovation in a public sector context is defined as the search for creative or novel resolutions to problems and demands, including new services, new organisational structures and improved process (Currie et al., 2008).

Innovations have a propensity to be the result of strategic responses or projects through which organi-

sations operate effectively, and to which leadership of organisations must commit key and strategic resources to support innovations in order for these to succeed (Oke et al., 2009). In the achievement of organisational innovation, leadership plays a vital role in building the process, structures, and climate for an organisation to become innovative and to motivate team expectations toward innovations (Chan et al., 2014). As such, the significance of leadership style in creating an innovative organisation is not in question. Leadership style arises from a behavioural review of the approach in which leaders perform their functions (Liu et al., 2003). The research question addressed in this article is: What leadership styles support innovation in the public sector as perceived by engineering professionals?

In this study, the dimensionality of leadership for innovation was analysed using an exploratory factor analysis (EFA). EFA was employed to analyse the inter-relationship between variables and to explore the factor structure of their measure. EFA can be used to identify appropriate variables and analyse the relationships among large numbers of variables in the most general form, explaining them in terms of their common underlying dimensions (Hair et al., 2010).

The paper begins with a literature review, then describes the methodology employed, followed by the results. The paper then discusses the findings and ends with key conclusions from the study.

1. Literature review

The aim of this section is to bring together some key contributions from the literature on leadership styles in the public sector. This section provides a comprehensive and structured perspective on how leadership style in the public sector is theoretically understood. Relevant research and empirical studies are critically reviewed to provide a theoretical foundation to the research question.

According to Bass and Bass (2009), leadership refers to an interaction between two or more members of a group that often involves a structuring or restructuring of the situation and of the perceptions and expectations of the members so as to achieve the common goals. Leadership is one of the most critical predictors when considering the degree to which subordinates strive for creativity and innovation (Amabile et al., 2004; Panuwatwanich et al., 2008). For example, Kim and Lee (2009) investigated man-

agement capacity in the innovation process in the Korean public sector and highlighted the importance of innovative leadership on the adoption and implementation of innovations. The willingness of leaders to take risks on novel initiatives and adopt fresh perspectives is the main factor in the success of innovation implementation (Orazi et al., 2013).

The current literature on leadership emphasises different characteristics that can facilitate innovation. One of leadership styles that is considered appropriate to enhance innovation in changing environment is transformational leadership. For example, Shin and Zhou (2003) indicated there was a positive relationship between transformational leadership and employee creativity. In contrast, transactional leadership is characterised by individual gain and the exchange of rewards for effort, and there is a well-defined hierarchy. However, compared to the transformational style of leadership, a study by Pastor and Mayo (2006) found that transactional leadership had less impact on employee learning and creativity. Additionally, literature about governance, collaboration and networks in the public sector has highlighted consideration leadership style which focuses on support and concern for employees. Thus, two leadership styles have been identified in terms of their relevance to innovation and public leadership: transformational leadership and consideration leadership.

1.1. Transformational leadership

Since Burns (1978) introduced the concept of transformational leadership, many scholars and practitioners have paid increasing attention to studying the effectiveness of this leadership style (Bass & Riggio, 2006; Wright & Pandey, 2009; Yukl, 2006). Transformational leadership has generally been considered more effective than other leadership styles in facilitating employee creativity and organisational innovation (García-Morales et al., 2012; Shin & Zhou, 2003). Transformational leaders are those who inspire subordinates to perform and recognise organisational objectives and goals and have the capability to motivate followers beyond expected levels of work standards. Consequently, subordinates feel engaged and personally rewarded through their job, and work outcomes, such as job satisfaction and extra effort, are increased (Bass & Riggio, 2006). In contrast to transactional leadership, transformational leaders motivate behaviour by changing the basic values, beliefs, attitudes and assumptions of subordinates. To direct and inspire individual effort, these leaders transform

their subordinates by raising their awareness of the importance of organisational outcomes, which, in turn, activates their higher-order needs and induces them to transcend their own self-interests for the benefit of the organisation (Wright & Pandey, 2009).

In the public sector, transformational leadership has a mission-driven form which boosts follower receptivity to reform and innovation (Gabris et al., 2001). Emphasis on the mission of an organisation makes transformational leadership particularly effective in the public sector given the service and community-oriented characteristics of their responsibilities (Wright & Pandey, 2009). Furthermore, Wright et al. (2012), in their national study of city managers and department heads, found that transformational leadership was associated with a developmental culture characterised by innovation, entrepreneurial risk-taking, and growth. The transformational leader encourages new ideas and practices by supporting subordinates with sufficient autonomy and discretion for innovation to emerge (Gumusluoglu & Ilsev, 2009). Similarly, transformational leadership has been shown to increase employee empowerment even in public sectors associated with high levels of bureaucracy and a strict hierarchy (Park & Rainey, 2008).

1.2. Consideration leadership

In addition to transformational leadership, the characteristics of consideration leadership also play a vital role in innovation outcomes (Yukl, 2006). Consideration is one of the two leader behavioural dimensions identified by the research cadre at the Ohio State University in the late 1940s (Lee & Kwak, 2014). More than a thousand leader behaviours were examined and summarised into two groups: consideration and initiating structure (Halpin, 1957). Consideration is the degree to which a leader shows concern and expressions of support for subordinates, looks out for their welfare, treats members as equal, and displays warmth and approachability (Bass & Bass, 2009). Initiating structure is the degree to which a leader clarifies the task responsibilities of the leader and of subordinates, determines standards of performance, and establishes well-defined patterns and channels of communication. Consideration leader behaviours provide a work environment of emotional support, friendliness, warmth, and trust for followers. Some exemplary behaviours are helping followers with personal problems, being approachable, advising employees regarding personal problems, and

expressing appreciation and support (Lee & Kwak, 2014).

Consideration leadership promotes empowerment of individual subordinates, and this relates to innovative behaviour and effectiveness. According to Frischer (1993), the empowering manager perceives the influence of individuals and work groups and thus, creates an innovative climate where subordinates achieve better results in their innovative initiatives. Consideration leadership also manages the negative issues related to diversity; that is the potential "us – them" differentiations and subsequent breakdown in relationships, because it restricts subgroup classification processes and smoothes relational processes, both of which play important roles in the effective functioning of diverse groups (Mannix & Neale, 2005). The staff always expects the leadership to be a human being and considerate but also to be genuine.

2. Research methods

Data released by the Australian Public Service Commission (APSC) from the 2014 APS employee census was used for this study. The target population for this study was the engineering profession in Commonwealth departments which was classified as the Engineering and Technical Family in the APSC Job Family Model. Of all respondents, 3 570 respondents reported the type of work as Engineering and Technical Family. Cases, where an entire section was left blank, were eliminated from the sample as nonresponsive. As a result, data cleaning further reduced the sample size to 3 125. The instrument used in this paper was adapted by the researchers after an extensive review of all the questions in the 2014 APS employee census. The 11 survey questions were selected and grouped according to leadership theory and were used to measure leadership styles that enable innovation. Building on the ideas of innovation, the respondents were given the following definition of innovation: 'to find new ways of doing work and solving problems'.

The quantitative analysis commenced with multivariate statistics to analyse the data using the Statistical Package for the Social Sciences (SPSS) version 22 software. The data analysis started with univariate data screening which included the examination of missing data, item normality, and the detection of possible outliers. Descriptive analysis was employed to gain a feel for the data and to consider whether the

obtained data was suitable for multivariate analysis and could be used as one data set. To confirm the homogeneity of responses, analysis of variance (ANOVA) was conducted to determine whether the data could be used to represent a single dataset.

The validity of the measurement scale was evaluated using exploratory factor analysis (EFA). EFA was conducted to condense the large number of items into a smaller, more controllable set of dimensions (Hair et al., 2010). In this paper, EFA was applied to determine the adequate number of latent factor structures and to identify the number of factors underlying, conceptually and statistically, the set of items in each construct. In general, the EFA technique identifies appropriate variables and analyses the relationships among large numbers of variables in the most general form, explaining them in terms of their common underlying dimensions (Hair et al., 2010). The results from the EFA provided a clear estimation of the factor structure of variables.

3. Descriptive analysis

3.1. Demographic profiles

Understanding the characteristics of the collected sample is important to determine whether the sample could sufficiently represent the population of interest. This is necessary to establish the validity of the conclusions drawn for the whole population. The demographic factors undertaken in this study were gender, age group, classification level, the length of service, qualification, agency cluster and agency size.

Analyses of the demographic data suggested that the sample for this research was valid and adequately representative of the whole population. The sample population represented a gender mix of 14% female and 86% male predominantly aged between 45 and 59 (49%) who had total length of service for more than 5 years (73%); 68% worked in an operational role (APS 1–6) and were well educated, with 78% holding tertiary qualifications (Bachelor or higher); 86% worked in operational agencies, and 91% worked in large agencies (>1 000 employees). The distribution of these variables approximated the distribution of the population from which they were drawn.

3.2. Data screening

The data screening started with the univariate data screening which included the examination of missing data, item normality, and the detection of possible outliers. This was conducted to ensure there would be no corrupted data which could affect the accuracy of the estimation in the subsequent analysis (Tabachnick & Fidell, 2007).

Missing data is one of the most common problems in data analysis. The result of a Missing Completely at Random (MCAR) test yielded non-significant Chi-square statistics (χ^2= 167.384, df = 180, Sig. = 0.741) demonstrating a non-significant difference between the observed missing data pattern and a random pattern, and highlighting that the missing data were randomly distributed. As the percentage of missing data consisted of less than 5% of the total responses and the pattern was completely random, then any imputation method could be applied (Hair et al., 2010; Tabachnick & Fidell, 2007). Therefore, the missing data were imputed by the Expectation Maximisation approach. This technique iteratively goes through the data while still preserving its covariance structure (Ghomrawi et al., 2011).

The normality of the data was investigated by calculating the statistics of skewness and kurtosis and comparing them with the 'rule of thumb values' of ±2.58 (Hair et al., 2010). Skewness is a measure of symmetry which affects tests of means, whereas kurtosis is a measure of how the peakedness of a distribution impacts tests of variances and covariances. The skewness values ranged from -1.25 to -0.64, and were thus inside the threshold, which indicated that the respondents answered these questions quite similarly. The kurtosis values ranged from -0.07 to +2.20, again falling within the recommendation range (Table 1). This is consistent with expectations that the effect of skewness and kurtosis disappears with samples of 200 or more (Tabachnick & Fidell, 2007).

Outliers refer to scores that have a substantial difference between actual and predicted values of the observations (Hair et al., 2010). Cases with responses greater than three standard deviations beyond the mean may be determined outliers, which can be calculated from an absolute value of z-scores (|z|) greater than 3.29 (Kline, 2015; Tabachnick & Fidell, 2007). Four variables containing cases with an absolute value of z-scores (|z|) greater than 3.29 had outliers from 0.6 to 2.3 percent. Based on Field's suggestions (Field, 2013), the number of such outliers should be less than one percent. Therefore, the number of these outliers was moderate compared with a standard level.

To confirm that the outliers did not bias the means, the difference of the mean and the '5% trimmed

Tab. 1. Covariance structure analysis: descriptive statistics

VARIABLE	MEAN	SD	SKEWNESS	KURTOSIS
A1: Motivate people to understand the strategic direction of the APS	3.51	1.04	-0.64	-0.07
A2: Encourage people to find new ways of doing work	3.57	1.01	-0.67	0.14
A3: Encourages people to learn from work and develop new skills	3.57	1.03	-0.71	0.12
A4: Achieve results by building agency capability and responsiveness	3.78	0.91	-0.91	0.96
A5: Cultivate productive working relationships	3.71	1.00	-0.86	0.43
A6: My supervisor is open to new ideas	3.85	0.88	-0.97	1.26
A7: My supervisor communicates effectively regarding the risks	3.72	0.99	-0.83	0.43
A8: My supervisor accepts people from diverse backgrounds	4.09	0.72	-0.79	1.69
A9: Work effectively with people from diverse backgrounds	3.96	0.77	-0.85	1.75
A10: My supervisor is committed to workplace safety	4.12	0.69	-0.85	2.18
A11: My supervisor treats people with respect	4.02	0.87	-1.25	2.20

Source: authors' calculation using SPSS program.

mean' of each variable was calculated to determine whether the outliers may have distorted the data. The 5% trimmed mean refers to a mean calculated from a set of observations where the five percent of the scores in the upper and lower bounds are removed.

Tab. 2. Outliers analysis

QUESTION	CASE WITH $|z| > 3.29$	MEAN	5% TRIMMED MEAN	Δ MEAN
A8	0.6%	4.09	4.13	0.04
A9	1.2%	3.96	4.00	0.04
A10	0.6%	4.12	4.16	0.04
A11	2.3%	4.03	4.11	0.08

Source: authors' calculation using SPSS program.

The outliers may cause a problem to the dataset if the difference between the mean and the '5% trimmed mean' is greater than 0.20 (Pallant, 2013). The extent of the difference of every variable was relatively small, ranging from 0.04 to 0.08 (Table 2). Thus, these results confirmed that the detected outliers did not distort the data set and therefore, all 3 125 cases were retained for further analysis.

3.3. PRELIMINARY FINDINGS

The descriptive analysis was presented based on the values of mean and standard deviation. The mean value is the central tendency measurement, used to describe the average opinion of the respondents and to obtain an overall picture of the respondents' perceptions regarding each variable. This section evaluates and interprets the mean values of all 11 variables (Table 1). The respondents stated their agreement that their supervisors had strong innovation conducive behaviours, indicated by the mean value of the 'leadership for innovation' being higher than the medium level of 3.00, ranging from 3.51 to 4.12. Employees were positive regarding their supervisors' support for innovation (A2; 3.57) and openness to new ideas (A6; 3.85). Supervisory capabilities were particularly appreciated in the areas included in the APS Integrated Leadership System (Podger et al., 2004), such as motivating people (A1; 3.51), developing people (A3; 3.57), and achieving results (A4; 3.80). Compared to the other variables, most subordinates had a more positive view of their supervisors' characteristics in terms of accepting members from diverse backgrounds (A8; 4.09) and working effectively with them (A9; 3.96). Subordinates were most likely to be satisfied with their supervisors for their expression of respect for subordinates (A10; 4.12) and their commitment to workplace safety (A11; 4.03).

3.4. ANOVA TEST OF SINGLE SAMPLE

After screening the data set, one-way analysis of variance (ANOVA) was undertaken to determine whether significant differences existed between the opinions evident in the responses of managers and subordinates in APS. Subordinates are classified as employees who perform at levels between APS 1 to APS 6, the lowest strands of employment classification, where staff are accorded little or no managerial responsibilities, whereas Executive Level (EL) staff represent middle management including sectional heads within departments.

ANOVA was conducted to compare the variance between the mean score of these two groups. ANOVA is conducted to calculate the ratio of systematic vari-

ance to unsystematic variance (*F*-ratio) in an experimental study by comparing the variance between the mean score of these two groups (Field, 2013). If the amount of the ANOVA's *F* statistic is significant, it indicates that the means for managerial and subordinate staff are not statistically equal. However, as recommended by Panuwatwanich (2008), the value of the mean difference should also be considered. The difference is considered significant if the difference is greater than 1.00 representing one category difference in opinion. Moreover, the effect size of the difference (η^2) needs to be considered. The effect size can be calculated by dividing the sum of squares between-group by the total sum of squares. If the effect size is small (i.e. less than 0.14), the significant difference between the mean, as identified by *F*-ratio may not be of practical importance (Pallant, 2013).

Tabachnick and Fidell (2007), data is factorable when the KMO is above the minimum acceptable level of 0.60. KMO values over 0.8 indicate that included variables are 'meritoriously' predicted without error by other variables. In this study, the KMO value of the variables was 0.943, which indicated sampling adequacy and that the distribution of the values in the matrix was appropriate to conduct factor analysis (George & Mallery, 2016). The value obtained by Bartlett's test of sphericity, χ^2 (55) was 31673.31 which was highly significant at $p < 0.001$ level, indicating that the data were approximately multivariate normal (George & Mallery, 2016; Lattin et al., 2003). The result also confirmed that the correlation matrix could not be construed as an identity matrix (Lattin et al., 2003), and therefore, was sufficient to test the factor analysis.

Tab. 3. ANOVA results for subordinate and manager

| VARIABLE | F | SIG. | MEAN | | Δ MEAN | EFFECT SIZE |
			SUBORDINATE	MANAGER		
A8	12.707	0.000	4.06	4.16	0.10	0.004
A9	5.931	0.015	3.94	4.01	0.07	0.002

Source: authors' calculation using SPSS program.

The results of ANOVA were based on opinions of the engineering professionals from the operational level (n = 2203) and managerial level (n = 912). As shown in Table 3, the results obtained in the ANOVA analysis revealed a statistically significant difference of 2 variables. However, there was neither a large mean difference nor a large effect size. As a result, all 11 variables were retained in the data set for further analysis.

4. EXPLORATORY FACTOR ANALYSIS

Two basic assumptions of factor analysis, multivariate normality and sampling adequacy, should be tested before extracting the factors to confirm the suitability of the collected data for the EFA (Lattin et al., 2003). By using SPSS, Bartlett's test of sphericity can determine the multivariate normality of the variables. In addition, this test is used to validate the hypothesis that the correlation matrix is an identity matrix (i.e., a spherical set of multivariate data), (Lattin et al., 2003). The Kaiser-Meyer-Olkin (KMO) test evaluates sampling adequacy regarding whether the distribution of values is sufficient for conducting factor analysis (George & Mallery, 2016). According to

To develop an appropriate solution that shows an adequate number of factors best representing the interrelations among the set of variables, the EFA conducted two essential steps: factor extraction; and factor rotation and explanation (Pallant, 2013; Tabachnick & Fidell, 2007). Factor extraction reveals factors based on the adequacy of the number of factors, while factor rotation improves the explanation of a given factor solution (Field, 2013; Tabachnick & Fidell, 2007). Principal component analysis (PCA) was chosen as a data extraction method because its primary objective is to summarise and reduce data as well as define the factors needed to represent the structure of a variable (Hair et al., 2010). The goal of PCA is to extract the maximum variance from the data set with each component.

Four criteria are used to achieve the number of factors that best describe the underlying relationship among variables, namely: 1) latent root criterion; 2) Catell's scree test; 3) percentage of variance criterion; and 4) a priori criterion (Hair et al., 2010). The latent root criterion recommends that factors be extracted based on total variance, using eigenvalue set to unity (value = 1.0). The Catell's scree test employs a graphical plot of the eigenvalue of the factor in their order of extraction in which a sudden change of slope in the graph indicates the maximum number of factors to

be extracted and determines the number of factors to retain (Pallant, 2013). To determine a sudden change of slope, researchers draw a horizontal line and a vertical line starting from each end of the curve. The percentage of variance criterion is used to confirm practical significance for the extracted factors through which the particular amount of variance is explained (Tabachnick & Fidell, 2007). A priori criterion is a simple and reasonable criterion in which the number of factors is known prior to conducting the factor analysis. As well as considering these four criteria, the conceptual foundation should also be integrated with empirical evidence when considering the appropriate factors to extract (Hair et al., 2010). Once the factors are extracted, factor loadings are used to determine the degree to which the variables load onto these factors (Field, 2013).

After the factor extraction, factor rotation is conducted to present the pattern of loadings in a format that is easy to understand. Varimax rotation, which can load variables to factors clearly, was conducted to maximise the variance of factor loadings and minimise the number of variables that had high loadings on each other (Pallant, 2013; Tabachnick & Fidell, 2007). The resultant factors are presented in a rotated component matrix, and are justified by factor loadings that indicate the degree of correlation between each variable and the factor. A factor loading of 0.50 is considered to be practically significant and therefore has been used as the cut-off level in this study.

Initially, there was a total of 11 variables, chosen to operationally define the Leadership for Innovation (LFI). The EFA was conducted to form a smaller manageable dimension. The two factors for the LFI construct were produced using a priori criterion because the construct was clearly conceptualised to have two distinct components: transformational leadership and consideration leadership.

A geometrical approach can be adopted by the EFA in which factors can be visualised in a coordinate system. The factors are represented by the axes of a graph in which variables are plotted (Field, 2013). When the coordinates of variables are in close proximity to each graph, this represents the strength relationship between that variable and each factor. This scenario indicates that the variable is related to that particular factor. The coordinate of a variable along the factor axis, which acts as a reference frame, represents a factor loading. The variables were plotted as a function of the factors, as shown in Fig. 1. Six variables (A1, A2, A3, …, A6) have high factor loadings (i.e., a strong relationship) with factor 1 (transforma-
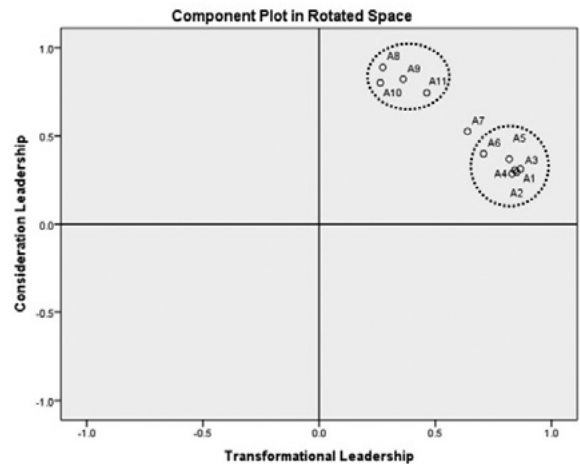

Fig. 1. Geometrical representation of factor analysis of LFI

Source: authors' calculation using SPSS program.

tional leadership: horizontal axis) but have a low correlation with factor 2 (consideration leadership: vertical axis). In contrast, four variables have strong relationships with consideration leadership but low correlation with transformational leadership.

The Cattell's scree test employs a graphical plot of the eigenvalue of the factor in their order of extraction in which a sudden change of slope in the graph indicates the maximum number of factors to be extracted and determines the number of factors to retain (Pallant, 2013). A horizontal line and a vertical line beginning at each end of the curve were drawn to ascertain if there was a sudden change of slope. Examination of the scree plot indicated that a sudden change of slope occurred after the second component (Fig. 2). The Cattell's scree test also identified these two factors, which accounted for 77.6 percent of the total variance.

Prior to extracting factors, communality estimates must be generated. Communality is the proportion of observed variance accounted for by the common factors. These values represent the total amount of variance for an item explained by the extracted factors. The communality is denoted by h^2 and is the summation of the squared factor loadings of a variable across factor (Tabachnick & Fidell, 2007). Generally, a variable will be excluded from the analysis if it has low communalities (less than 0.20), which means that 80% is unique variance. This is because the objective of factor analysis is to describe the variance through the common factors (Child, 2006).

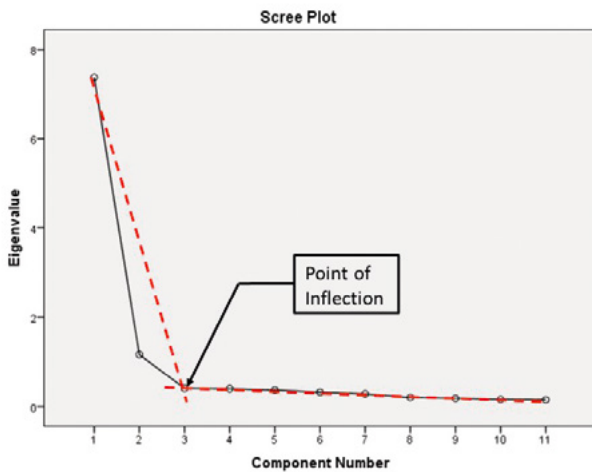The formula for deriving the communalities is (Cattell, 1973):

Fig. 2. Scree plot of principal component factoring

Source: authors' calculation using SPSS program.

$$h_j^2 = a_{j1}^2 + a_{j2}^2 ... \cdots + a_{jm}^2 \qquad (1)$$

where: *a* equals the loadings for *j* variables.

Using the factor loadings in Table 4, the communality of variable A1 was calculated using the aforementioned formula:

$$h_{A1}^2 = 0.866^2 + 0.312^2 = 0.848. \qquad (2)$$

Table 4 represents the factor loadings and the contribution of each variable to the factors. In this case, A1 has the highest contribution to Factor 1. The calculated communality indicates that based on the knowledge of the two factors 84.8% of variable A1 can be predicted. If a variable has a high communality, the set of factors can be said to explain much of the variance of a variable (Kline, 2015).

The loading patterns of all 11 variables revealed that variable A7 was cross loaded two constructs, and was thus eliminated. Therefore, 10 variables with factor loadings ranging from 0.708 to 0.889 were retained. The variables with high loadings on component 1 centred on transformational leadership, whereas the variables with high loadings on component 2 were concerned primarily with consideration leadership. Based on these 10 variables, Cronbach's alpha coefficient was recalculated yielding a value of 0.945, indicating the modified measurement scale still had very good internal consistency.

Overdetermination of a factor is the extent to which each factor is clearly shown to have an adequate number of variables and the degree to which each

Tab. 4. EFA of leadership for innovation

VARIABLE	ROTATED COMPONENT		H²
	1	2	
A1	0.866	0.312	0.848
A2	0.851	0.294	0.811
A3	0.842	0.306	0.803
A4	0.830	0.286	0.771
A5	0.818	0.369	0.806
A6	0.708	0.399	0.660
A7	0.639	0.526	0.685
A8	0.274	0.889	0.866
A9	0.362	0.822	0.807
A10	0.264	0.801	0.711
A11	0.463	0.745	0.769

Source: authors' calculation using SPSS program.

factor is sufficiently defined by a set of indicators. Highly overdetermined factors are determined when there are high factor loadings on at least three to four variables, these variables have moderate to high communalities (i.e., between 0.40 and 0.70 or higher), and exhibit good simple structure (Fabrigar et al., 1999; MacCallum et al., 1999). Both factors had four or more items per factor, the factor loadings ranged from 0.708 to 0.889 and communalities ranged from 0.660 to 0.866, indicating relatively strong data.

Tab. 5. Factors of leadership for innovation

FACTOR	DESCRIPTION	% OF THE VARIANCE
Transformational leadership	motivate people, encourage innovation, develop people, achieve results, cultivate relationships, and open to new ideas	67.1
Consideration leadership	accept and work with diverse people, commit to workplace safety, and treats people with respect	10.5

Source: authors' calculation using SPSS program.

Table 5 shows the two leadership factors from EFA. It shows there is one very strong factor, which explains 67.1 per cent of the variance and involves a group of variables that relate to transformation leadership styles such as commitment, encouragement, stimulation, intelligence and achievement. This has been labelled 'transformational leadership'. The second innovation leadership type relates to the 'consideration leadership' style which concerns a view to show trust in followers and to provide a safe work

environment, accept diversity, and treat employees respectfully. These second factors explain only small proportions of the variance of 10.5 per cent.

Conclusions

In this paper, a comprehensive investigation of leadership for innovation in the public sector is presented. Perspectives on leadership for innovation were identified by EFA using principal component analysis (PCA) with varimax rotation to assess the dimensionality of the leadership for innovation construct. To interpret the meaning of a factor, the salient variables in each factor were identified and used as the indicators for explanation. The salient variables identified for each extracted factor were higher than 0.5, indicating a substantial degree of contribution of each variable to its extracted factor.

Two factors were extracted from the 11 variables which were selected and grouped according to leadership theory. From the results, one variable was cross loaded between two constructs, and was thus eliminated. Thus, 10 variables with factor loadings ranging from 0.708 to 0.889 were retained. The findings from this study confirm that the accuracy of factor solutions of the EFA model is dependent on the magnitudes of communalities and factor loadings as well as the degree of overdetermination. This finding supports results from other studies emphasising the importance of high factor loadings, high communalities, and overdetermination in achieving quality factor solutions (Hogarty et al., 2005; MacCallum et al., 1999).

The two factors extracted as characterising leadership for innovation were transformational leadership and consideration leadership. This paper shows that transformational leadership and consideration leadership are two predominant styles of leadership within the realm of innovation in the public sector. This result was indicated by these two factors explained for 77.6 percent of the total variance. Based on the views of respondents in the survey, transformational leadership explains 67.1 percent of the variance and appears as the strongest set of qualities that play a vital role for innovation. Although transformational leadership is accepted widely in the literature as a leadership style in facilitating employee creativity and organisational innovation (García-Morales et al., 2012; Shin & Zhou, 2003), consideration leadership is recognised to a lesser extent. In contrast, this study has identified consideration leadership, which explains proportions of the variance 10.5 percent, as being a complement to transformational leadership in supporting employee creativity and innovation. This finding is consistent with other studies which emphasise that these two leadership behaviours increase leader effectiveness ratings, as they establish the leader as being stable and genuine in the view of the followers (Johnson et al., 2012). It is recommended that both leadership styles be incorporated into management training and development programmes. This study also recommends that Commonwealth departments recruit supervisors who have both of these leadership styles before implementing innovative projects. It is also important that future research identifies how both leadership styles impact on workplace innovation and to investigate successful workplace innovation practices to provide empirical evidence to support such relationships. Such a study is currently being completed by this research team.

Nevertheless, this paper has some limitations. This study is focused only on Australia which has predominantly an Anglo-Saxon culture. This limits the extent to which findings can be generalised as representative of all cultures. It would be interesting, in future studies, to investigate which leadership styles support innovation in the Eastern world. These eastern countries have been exposed to Confucian values, bureaucratic culture, high power distance, and autocratic decision-making style which discourage bottom-up innovation and encourage top-down innovation in public sectors (Kim & Lee, 2009; Lok & Crawford, 2004).

Acknowledgements

LITERATURE

Amabile, T. M., Schatzel, E. A., Moneta, G. B., & Kramer, S. J. (2004). Leader behaviors and the work environment for creativity: Perceived leader support. *The Leadership Quarterly, 15*(1), 5-32. doi:10.1016/j.leaqua.2003.12.003

Arundel, A., & Huber, D. (2013). From too little to too much innovation? Issues in measuring innovation in the public sector. *Structural Change and Economic Dynamics, 27*, 146-159. doi:10.1016/j.strueco.2013.06.009

Bass, B. M., & Bass, R. (2009). *The Bass handbook of leadership: Theory, research, and managerial applications*. New York: Simon and Schuster.

Bass, B. M., & Riggio, R. E. (2006). *Transformational leadership*. New Jersey: Psychology Press.

Burns, J. M. (1978). *Leadership*. New York: Harper & Row.

Chan, I. Y. S., Liu, A. M. M., & Fellows, R. (2014). Role of leadership in fostering an innovation climate in construction firms. *Journal of Management in Engineering, 30*(6), 06014003. doi:10.1061/(ASCE)ME.1943-5479.0000271

Currie, G., Humphreys, M., Ucbasaran, D., & McManus, S. (2008). Entrepreneurial leadership in the English public sector: paradox or possibility? *Public Administration, 86*(4), 987-1008. doi:10.1111/j.1467-9299.2008.00736.x

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological methods, 4*(3), 272-299. doi:10.1037/1082-989X.4.3.272

Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). London: SAGE Publications.

Frischer, J. (1993). Empowering management in new product development units. *Journal of Product Innovation Management, 10*(5), 393-402. doi:10.1111/1540-5885.1050393

Gabris, G. T., Golembiewski, R. T., & Ihrke, D. M. (2001). Leadership credibility, board relations, and administrative innovation at the local government level. *Journal of Public Administration Research and Theory, 11*(1), 89-108.

García-Morales, V. J., Jiménez-Barrionuevo, M. M., & Gutiérrez-Gutiérrez, L. (2012). Transformational leadership influence on organizational performance through organizational learning and innovation. *Journal of Business Research, 65*(7), 1040-1050. doi:10.1016/j.jbusres.2011.03.005

George, D., & Mallery, P. (2016). *IBM SPSS Statistics 23 Step by Step: A Simple Guide and Reference*. New York, NY: Routledge.

Ghomrawi, H. M., Mandl, L. A., Rutledge, J., Alexiades, M. M., & Mazumdar, M. (2011). Is there a role for expectation maximization imputation in addressing missing data in research using WOMAC questionnaire? Comparison to the standard mean approach and a tutorial. *BMC Musculoskeletal Disorders, 12*(1), 1.

Gumusluoglu, L., & Ilsev, A. (2009). Transformational leadership, creativity, and organizational innovation. *Journal of Business Research, 62*(4), 461-473. doi:10.1016/j.jbusres.2007.07.032

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis: A global perspective*. Basım Pearson Education.

Halpin, A. W. (1957). *Manual for the leader behavior description questionnaire*: Bureau of Business Research, College of Commerce and Administration, The Ohio State University.

Hogarty, K. Y., Hines, C. V., Kromrey, J. D., Ferron, J. M., & Mumford, K. R. (2005). The Quality of Factor Solutions in Exploratory Factor Analysis: The Influence of Sample Size, Communality, and Overdetermination. *Educational and Psychological Measurement, 65*(2), 202-226. doi:10.1177/0013164404267287

Johnson, R. E., Venus, M., Lanaj, K., Mao, C., & Chang, C.-H. (2012). Leader identity as an antecedent of the frequency and consistency of transformational, consideration, and abusive leadership behaviors. *Journal of Applied Psychology, 97*(6), 1262-1272. doi:10.1037/a0029043

Kim, S. E., & Lee, J. W. (2009). The impact of management capacity on government innovation in Korea: An empirical study. *International Public Management Journal, 12*(3), 345-369. doi:10.1080/10967490903103334

Kline, R. B. (2015). *Principles and practice of structural equation modeling*. New York, NY: Guilford publications.

Lattin, J. M., Carroll, J. D., & Green, P. E. (2003). *Analyzing multivariate data*. Cole Pacific Grove, CA: Thomson Brooks.

Lee, D., & Kwak, W. J. (2014). Interactive effects of consideration leadership on the association of injury with training among home health aides. *Leadership in Health Services, 27*(1), 41-50. doi:10.1108/LHS-07-2012-0024

Liu, A., Fellows, R., & Fang, Z. (2003). The power paradigm of project leadership. *Construction Management and Economics, 21*(8), 819-829. doi:10.1080/0144619032000056199

Lok, P., & Crawford, J. (2004). The effect of organisational culture and leadership style on job satisfaction and organisational commitment: A cross-national comparison. *Journal of Management Development, 23*(4), 321-338. doi:10.1108/02621710410529785

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological methods, 4*(1), 84-99. doi:10.1037/1082-989X.4.1.84

Mannix, E., & Neale, M. A. (2005). What differences make a difference? The promise and reality of diverse teams in organizations. *Psychological Science in the Public Interest, 6*(2), 31-55. doi:10.1111/j.1529-1006.2005.00022.x

Moore, M., & Hartley, J. (2008). Innovations in governance. *Public Management Review, 10*(1), 3-20. doi:10.1080/14719030701763161

Oke, A., Munshi, N., & Walumbwa, F. O. (2009). The influence of leadership on innovation processes and activities. *Organizational Dynamics, 38*(1), 64-72. doi:10.1016/j.orgdyn.2008.10.005

Orazi, D. C., Turrini, A., & Valotti, G. (2013). Public sector leadership: new perspectives for research and practice. *International Review of Administrative Sciences, 79*(3), 486-504. doi:10.1177/0020852313489945

Pallant, J. (2013). *SPSS survival manual: a step by step guide to data analysis using IBM SPSS*. Maidenhead, UK: McGraw-Hill.

Panuwatwanich, K. (2008). *Modelling the innovation diffusion process in Australian architectural and engineering design organisations.* (Doctoral Dissertation), Griffith University.

Panuwatwanich, K., Stewart, R. A., & Mohamed, S. (2008). The role of climate for innovation in enhancing business performance: The case of design firms. *Engineering, Construction and Architectural Management, 15*(5), 407-422. doi:10.1108/09699980810902712

Park, S. M., & Rainey, H. G. (2008). Leadership and public service motivation in US federal agencies. *International Public Management Journal, 11*(1), 109-142. doi:10.1080/10967490801887954

Pastor, J. C., & Mayo, M. (2006). Transformational and transactional leadership: an examination of managerial cognition among Spanish upper echelons. *Instituto de Empresa Business School Working Paper No. WP06-13*.

Podger, A., Simic, A., Halton, J., Shergold, P., & Maher, T. (2004). Integrated leadership system in the Australian Public Service. *Australian Journal of Public Administration, 63*(4), 108-118. doi:10.1111/j.1467-8500.2004.00407.x

Shin, S. J., & Zhou, J. (2003). Transformational Leadership, Conservation, and Creativity: Evidence From Korea. *Academy of Management Journal, 46*(6), 703-714. doi:10.2307/30040662

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics*. Needham Height, MA: Allyn & Bacon.

Wright, B. E., Moynihan, D. P., & Pandey, S. K. (2012). Pulling the Levers: Transformational Leadership, Public Service Motivation, and Mission Valence. *Public Administration Review, 72*(2), 206-215. doi:10.1111/j.1540-6210.2011.02496.x

Wright, B. E., & Pandey, S. K. (2009). Transformational leadership in the public sector: Does structure matter? *Journal of Public Administration Research and Theory*. doi:10.1093/jopart/mup003

Yukl, G. A. (2006). *Leadership in organizations*. Upper Saddle River, NJ: Prentice-Hall.