

Change in association between workplace traits and job outcomes over time

Do Associations Between Employee Self-Reported Organisational Assessments and Attitudinal Outcomes Change Over Time? An Analysis of Four Veterans Health Administration Surveys Using Structural Equation Modelling.

KEY WORDS: job outcomes; organisational assessment; longitudinal survey; structural equation modelling; Veterans Health Administration

SUMMARY

This paper evaluates relationships between healthcare employees' perceptions of three hospital organisational constructs (Leadership, Support and Resources), and their assessment of two employee-related outcomes (employee satisfaction, retention) and two patient-related outcomes (patient satisfaction, quality of care). Using four all-employee surveys conducted by the Veterans Health Administration in the United States between 1997 and 2006, we examine the strength of these relationships and their changes over time. Exposure and outcome measures are employee-assessed in all the surveys. Because it can accommodate both latent and measured variables into the model, Structural Equation Modelling (SEM) is used to capture and quantify the relationship structure. The aim of the project is to identify possible intervention foci. The analyses revealed that employee-related outcomes are improved by increases in Leadership and Support, and, not surprisingly, the outcome variable of employee satisfaction reduced turnover intention. The employee assessed patient-related outcomes of satisfaction and quality of care were most improved by increases in Resources. Results also indicate that the three organizational constructs and the web of associations characterized by SEM underwent changes over the study period, perhaps in relation to changes in VHA policy emphases, changes in survey wording, and other possible unmeasured factors.

1. INTRODUCTION

It is recognized that the performance of an organisation is strongly related to the satisfaction of its employees (Becker and Gerhart, 1996; Appelbaum *et al.*, 2000). The World Health Report (2006) has prioritized the development of healthy workplaces for health workers¹. Employee job satisfaction can have effects on employee health that can be both physical as well as psycho-social (Stansfeld *et al.*, 1997, 1998). Fisher and Sousa-Poza (2009) reported a positive relationship between employee job satisfaction and objective health measures. Other studies show that higher levels of employee stress are associated with increased personal insurance costs (Ganster *et al.*, 2001), decreased functional status (Cheng *et al.*, 2000), medication errors, and malpractice (NIOSH, 1999; Jones *et al.*, 1988). Among physicians, reduced satisfaction is associated with riskier prescribing profiles, lower levels of compliance with treatment protocols, and reduced patient satisfaction (Melville *et al.*, 1980; Linn *et al.*, 1985; DiMatteo *et al.*, 1993; Williams *et al.*, 2002; Williams and Skinner, 2003). Also, within hospitals, management practice, workforce capability, work design and hospital safety culture have a strong impact on the work environment of nurses, and thus on patient safety (Institute of Medicine, 2004). A growing body of evidence documents that organisational climate and work organisation (e.g., choices in staffing ratios) affect working conditions, employee health, job satisfaction and intention to quit, as well as on patient outcomes (Shields and Ward, 2001). Thus, the core relationship between

¹ Shamian and El-Jardali (2007) have investigated the impact of the World Health Report (2006) in the context of health workers in Canada.

Change in association between workplace traits and job outcomes over time organisational characteristics and employee working conditions has received increased attention.

Against this backdrop, this paper focuses on the Veterans Health Administration (VHA) healthcare system. The VHA is the largest integrated health care provider in the United States (US). The VHA has expended substantial efforts to improve quality and safety of patient care over the last decade, with considerable success (Jha *et al.*, 2003; Greenfield and Kaplan, 2004; Asch *et al.*, 2004). Healthcare research from the VHA experience also demonstrates the connection between hospital organisational climate, employee satisfaction, and quality and safety of care delivered to patients (Warren *et al.*, 2007; Stone *et al.*, 2005).

To maintain and improve quality of service, the VHA periodically assesses employee perceptions of organisational characteristics using the All-Employee Survey (AES), a census survey. This paper analyzes data from four AES administrations in 1997, 2001, 2004 and 2006², with the following aims: (1) To examine a broad spectrum of employee perceptions of their hospitals, and to determine their interrelationships, and their associations with four employee-assessed outcomes; (2) To identify possible foci for intervention strategies designed to improve employee working conditions and quality of care; (3) To identify marker variables to guide and evaluate these interventions; and (4) To determine whether the associations remain constant over time in the VHA system.

² Since 2006, the AES has been administered yearly.

Finally, the investigation also has a methodological aim. Structural Equation Modelling (SEM) is used to explore a more accurate method of capturing and quantifying the web of relationships within the AES through both latent and observed variables as well as net effect between variables in complex models. The paper is structured as follows: Section 2 describes the SEM model that addresses the objectives of the study and introduces a measure we will refer to as the ‘superbeta’. Section 3 presents the results of the VHA investigation based on this proposed SEM model. Section 4 presents a detailed discussion of the results, with conclusions in Section 5.

2 METHODS

2.1 Study population

All data for the analyses were extracted from four VHA AES administrations; all exposure and outcome measures are thus based on employee self-report³. All full and part-time permanent employees of the VHA were eligible to participate in each of the surveys⁴. Survey administration protocols evolved over this time period. The 1997 and 2001 AES were paper based only. Employees received a copy of the survey in their mailboxes, to be mailed back to a contractor for scanning, data

³ Thus the two outcomes assessing quality of care are only employee perceptions and do not necessarily reflect the perceptions of the patients themselves.

⁴ Contract employees, such as those working off-site in community-based outpatient clinics, house officers who were not paid through the VHA payroll system, and per diem nurses, who were paid through an agency, were not eligible.

Change in association between workplace traits and job outcomes over time cleaning and compilation. Survey administrators circulated follow-up electronic notices, facility calls, and national hotline call reminders. Administration protocols did not include attempts at follow-up of non-responders as labour partners were concerned about possible coercion and inappropriate follow-up. From the 2004 AES onwards, web and telephone-based Interactive Voice Recognition (IVR) options were added to the paper option. Respondents have increasingly chosen the web option over time.⁵ Table 1 summarizes usage of the 3 modalities in our study period.

[Table I ABOUT HERE]

After an initial drop in response rate between 1997 and 2001 from 55.2% to 36.5% (due primarily to problems with communication, coordination and marketing of the 2001 survey), there has been a steady increase in response rate: 51.9% in 2004 and 70.2% in 2006⁶. Reasons for this increase are explored in the Discussion. The numbers are detailed in Table II.

[Table II ABOUT HERE]

2.2 Survey Instrument

In this study, we focus only on the organisational perception portion of the larger AES, using items common to all instrument versions. These items were derived from the Organisational Assessment Survey (OAS) developed by the Office of Personnel Management (OPM, 2005) and a NIOSH (National Institute for Occupational Safety and Health) instrument (Hurrell and McLaney, 1988). All

⁵ In 2008, the percentage of respondents using web rose to over 92%.

⁶ The response rates were 76.2% in 2007 and 72.8% in 2008.

Change in association between workplace traits and job outcomes over time items and scales have been extensively validated by the source organisations. In addition, the National Center for Organizational Development (NCOD), which is now responsible for survey development and administration, conducts validation analyses of each year's survey items, using administrative data on employee- and patient-related outcomes as criteria. Response format for most of these items was on a five-point Likert scale, from 'Strongly disagree' to 'Strongly agree' (the NIOSH items used a 4-point response format in 1997 and 2001, only). Satisfaction questions used an analogous 'Not at all satisfied' to 'Very satisfied' format.

Although the AES has undergone substantial developmental change and reduction in the number of items over the time period considered in this analysis, this study identifies a subset of 25 items that are common to the 4 survey administrations. 21 of these items are treated as explanatory variables to capture the three latent organisational perception constructs: Leadership, Resources and Support. The remaining 4 items represent the four employee-assessed outcome variables. The wording of these items in the 1997 and 2001 questionnaires is identical. In the 2004 and 2006 AES administrations, the wording of most exposure variables changed slightly, being made more specific to the respondents' immediate work group by adding words such as 'in my workgroup', 'my supervisor', etc., where appropriate. These changes may have contributed to changes in the structural equations explored below.

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There were other minor changes between 2001 and 2004. The satisfaction outcomes were reworded to include the phrase — ‘Compared to what you think it should be ...’. The Retention (turnover intention reversed) outcome is somewhat different in all 4 surveys. However, in each of the surveys, the essence of these variables remains the same.

2.3 Data preparation

All ‘don’t know’ (DK) responses were recoded as missing values. The initial percentage of system missing values was quite low in all 4 surveys, generally < 1% for most items. The addition of the recoded DK responses resulted in final percentages of missing values ranging between 1% and 11% for most items. We chose not to impute values to missing responses as this can result in estimation bias (Acock, 2005). Missingness here is treated as missing completely at random (Rubin, 1976; Little and Rubin, 2002) as it did not seem that there was any obvious systematic pattern in the missing values. We chose the most conservative approach to missingness by excluding any case that returned a missing value for any of the 25 variables under investigation. This resulted in the exclusion of 40%, 38%, 31% and 26% of cases in 1997, 2001, 2004, and 2006, respectively

2.4 Structural equation model

Structural Equation Modelling (SEM) is a powerful multivariate modelling technique that handles scenarios in which the predictor and outcome variables can be either latent or observed. When latent variables are present in an investigation,

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observable (manifest) variables from the system (responses to questions in the survey questionnaire) are included in the model to generate the ‘best’ representation of the latent variables. Of the 25 AES observed variables, 4 are treated as outcomes and the remaining 21 are manifest exposure variables. The three organisational climate constructs, Leadership, Support and Resources, are unobserved latent constructs. The issues are (i) how to load these 21 manifest variables onto the three unobserved latent constructs; (ii) how to capture relationships among the three latent constructs, themselves; (iii) how to measure associations between the three latent constructs and the four outcomes; and (iv) how to quantify the broader web of direct and indirect relationships among the 3 latent constructs and 4 outcomes. Generally SEMs have two parts: the measurement model, which defines the relationships between the observed and latent constructs; and the structural model, which defines the relationships among the latent constructs (Bollen, 1989). SEMs can help to convert complex conceptualized relationship structures into a mathematical framework to estimate appropriate parameters of interest. Thus, the SEM approach can effectively address all of the above four issues.

Measurement Model:

Analyses were first carried out on the 1997 dataset; the model was then explored in the other 3 years to assess fit. Using the 21 manifest variables from the 1997 AES, SEM identified the 3 underlying latent constructs noted above: Leadership, Support and Resources. These are described as follows through their associated manifest variables:

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- ‘Leadership’ captures variables assessing managerial and supervisory characteristics, including fairness, motivation, innovation, performance evaluation, rewards and employee development;
- ‘Support’ captures immediate relationships within the workgroup, including diversity acceptance, respect, cooperation, employee involvement and conflict resolution;
- ‘Resources’ captures both ‘people-based’ and instrumental resources, such as availability of materials and information, safety climate and customer service.

There are 4 outcome variables, 2 employee-related and 2 patient-related respondents’ reports of:

- Satisfaction with their jobs (employee satisfaction)
- Intention to stay in VHA (retention)
- Assessment of patient satisfaction (customer satisfaction)
- Assessment of the overall quality of the service provided (quality)

Structural Model:

To estimate the associations between the three latent organisational constructs and the four outcome variables, we identify the ‘best’ fit model for the 1997 data.

[Figure 1 about here]

2.5 Mathematical derivation of the model

Latent constructs in a model can be purely theory driven, or they can be purely data driven, derived through factor analysis. Introduction of more factors sacrifices

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model parsimony, while fewer factors can sacrifice the model goodness-of-fit. The goal of using SEM is to strike a balance between theory, model parsimony and goodness-of-fit. The four outcome variables may not be entirely independent of each other; e.g., a more satisfied employee is more likely to remain in the system. Hence, in addition to the three latent organisational perception constructs, we introduce a fourth latent construct (Outcome), to capture any associations among the 4 outcome variables. The ‘best fit’⁷ model based on the 1997 survey, the model we analyze in this paper, is depicted in Figure 1. The latent constructs are depicted via ellipses, and the observed variables are depicted via rectangles.

In SEM analyses, the manifest variables can be associated with more than one of the underlying latent constructs. In our model, while some of the 21 manifest organisational perception variables are strongly associated with a single latent variable, other items in the survey reflect effects of all three latent organisational constructs. Thus, in the measurement model, we identify the two manifest variables that load most strongly onto each of the three latent variables and constrain them to this single loading, while the remaining 15 manifest variables are allowed to load onto all three latent constructs. In the structural model, we define the relationships

⁷ Various measures to quantify the goodness of fit of SEM are available in the literature, with each focusing on a particular aspect of the fit (Bentler and Chou, 1987; Hu and Bentler, 1999). For this investigation we report the Goodness-of-fit (GIF), the Adjusted Goodness-of-fit (AGIF), Chi-Square, Chi-Square/ DF, Akaike’s Information Criteria (AIC) (Akaike, 1973), Schwarz Bayesian Criteria (Schwarz, 1978), the non-normed Coefficient (Bentler and Bonet, 1980) and Hoelter’s Critical N (Hoelter, 1983) measures. The recommended ‘acceptable’ values and ‘good’ values of each of the fit are indicated for each of the fit criteria.

Change in association between workplace traits and job outcomes over time among the three latent organisational perception constructs (Leadership, Support and Resources). We then estimate the associations of the 4 employee-assessed outcome variables with the three primary latent organisational perception constructs, allowing for the influence of the secondary organisational perception construct (Outcome).

In notations, in terms of Figure 1, for the i^{th} individual, let $y_{ij}, j = 1, \dots, 25$, denote the 21 manifest variables and the 4 outcome variables. Further, let

$j = 1, \dots, 6$ correspond to the 6 manifest variables that we constrain to loading only on their respective latent variable, and let $j = 7, \dots, 21$ correspond to the remaining manifest variables that load onto all the three latent variables; while

$j = 22, \dots, 25$ correspond to the 4 outcome variables. Let $F_{ik}, k = 1, 2, 3$ denote the 3 latent organisational perception constructs, and F_{i4} denote the additional latent construct, Outcome. Then, for some linear function, denoted generically by f , and some generic *error*,

$$\begin{aligned}
 y_{ij} &= f(F_{i1}) + error_{ij}, j = 1, 2, \\
 y_{ij} &= f(F_{i2}) + error_{ij}, j = 3, 4, \\
 y_{ij} &= f(F_{i3}) + error_{ij}, j = 5, 6, \\
 y_{ij} &= f(F_{i1}, F_{i2}, F_{i3}) + error_{ij}, j = 7, \dots, 21, \\
 y_{ij} &= f(F_{i1}, F_{i2}, F_{i3}, F_{i4}) + error_{ij}, j = 22, \dots, 25, \\
 F_{i1} &= f(F_{i2}) + error_{i1}, \\
 F_{i3} &= f(F_{i1}, F_{i2}) + error_{i3}.
 \end{aligned}$$

A more complete mathematical version of the above is presented in Appendix A.

2.6 Quantification of Association

Our next focus is on obtaining an improved method to quantify the overall effects of associations between variables. Figure 1 provides the directional interpretation among the endogenous (dependent) and exogenous (independent or relatively independent) variables in the model, with the loadings providing means to compute the direct effect and total effect between each pair of dependent and independent components in the SEM (Bollen, 1989). However, the total effect measure may fail to capture the overall association between a pair in certain complex models. In fact, even if there is no direct arrow between a latent variable and a manifest variable, there can still be a quantifiable measure of association between the two through other relationships in the SEM network. We are thus led to the measure of association, called the *superbeta* measure, between a dependent variable and relatively independent variable described as follows:

$$\beta_{D^*, I^*}^{sb} = \text{Superbeta}(D^*, I^*) = \frac{\text{Cov}(D^*, I^*)}{\text{Var}(I^*)},$$

where I^* is the independent variable (either endogenous or exogenous) and D^* is the dependent variable (endogenous) in the relationship. Although this measure does not take into account the direction of the relationship between the variables, it can still account for any upstream relationship I^* may have with D^* and thus captures the overall association between the two variables. When I^* itself is an endogenous variable, this fact is further incorporated into the calculation until the most distal variable in the relationship is exogenous. In fact, the superbeta is the covariance between the dependent variable D^* and the root error term associated with the I^* variable, taking into account all the path coefficients involved. When I^*

Change in association between workplace traits and job outcomes over time is endogenous, the superbeta and total effect estimations can be different. When I^* is exogenous, the superbeta equals the corresponding total effect. Like the total effect measure, the superbeta can be decomposed into ‘the direct superbeta’ and ‘the indirect superbeta’. In an extreme scenario, as illustrated in the Appendix B, one can show that the total effect between a pair can be zero, yet the superbeta exists. The superbeta measure supplements the direct and the indirect effect measures in understanding the various associations that exist among the variables under a specific model. To compare corresponding associations across different survey years, we employ the standardized version of the superbeta measure using the commonly accepted delta method (Rao, 1973). The standardized superbeta is analogous to a correlation measure, and ranges between -1 and +1.

2.7 Hypothesis generation to investigate change over time

To address objective 4, to monitor change over time in the associations between the outcome variables and the latent organisational constructs, we perform a longitudinal analysis. We use the ‘best fit’ model from the 1997 AES as the reference model, and impose this model on the subsequent AES datasets to assess the fit as well as to measure deviations from the 1997 associations.

Software packages used in this paper are SPSS and SAS PROC CALIS. Factor analysis utilized principal components extraction with Varimax rotation; factors with eigen values > 1.0 were retained. Calculation of superbeta and standardized superbeta, corresponding t-values, standard error terms, p-values and 95%

Change in association between workplace traits and job outcomes over time confidence intervals, were done in SAS PROC IML using relevant PROC CALIS outputs.

3 RESULTS

Table III describes the factor loading structure for the 21 manifest variables; the 6 variables that are constrained to load on a single latent variables are represented in bold font. Changes in the factor loadings over time indicate the change in the covariance structure of the manifest variables, and hence the latent constructs, between the 1997-2001 and the 2004-2006 survey periods.

[Table III about here]

Based on Figure 1, the goodness of fit measures for the 4 AES years are reported in Table IV. The 1997 AES has the best fit, as data from that year were used to generate the null hypothesis model. The 2001 survey fit indices are very similar. However, fit indices drop successively in the 2004 and 2006 surveys, suggesting that their ‘best’ fit model moved away from the null hypothesized model based on the 1997 AES.

[Table IV about here]

Various measures of association between the four outcome variables and the 3 latent organisational perceptions constructs are presented in Table V and Figure 2. For the 1997 AES, employee satisfaction and retention are most strongly associated with Leadership, customer satisfaction is most strongly associated with Resources, and quality of service is most strongly related to Support. Across all the 4 surveys, retention remained most strongly associated with Leadership, while Customer

Change in association between workplace traits and job outcomes over time satisfaction was most strongly associated with Resources. The strongest associations of quality changed over the 4 years – in 1997 with Support, in 2001 with Leadership, and finally with Resources in 2001 and 2004. Employee satisfaction was most strongly associated with Leadership during 1997-2001, but in the last 2 surveys, it was associated with all 3 latent organisational perception constructs with very similar coefficients. Also, Table V demonstrates that the standardized superbeta measures indicate a similarity in the 2004 and 2006 surveys. All standardized superbeta quantities are positive and change in tandem with their corresponding total effect changes.

[Figure 2 about here]

The factor loading structure of the 21 manifest variables also shows a change in loading strength across the surveys (Table III). After tying 6 manifest variables to their respective latent variable, the strongest loading for five other manifest variables changed to another latent construct over these 4 survey periods: ‘Pay satisfaction’ loaded most strongly on Support in 1997, thereafter loading most strongly on Leadership; ‘Conflict resolution’ shifted maximum loading from Leadership to Support between the 1997–2001 and 2004–2006 periods; ‘Co-worker skills’ loaded most strongly on Resources in 1997, 2001 and 2006, but on Support in 2004; ‘Safety’ loaded most strongly on Leadership in 1997, thereafter loading most strongly on Resources; ‘Planning & Evaluation’ loaded most strongly on Resources in the 1997-2001 period, thereafter on Support during 2004–2006. ‘Employee involvement’ did not have any clear loading pattern in any of the 4

Change in association between workplace traits and job outcomes over time surveys. For the other manifest variables, the strongest loading patterns remained consistent over the 4 surveys.

4 DISCUSSION

Addressing Aim 1, recalling that all variables considered are based on exposure and outcome measures that are employee-assessed, the SEM analyses allowed us to quantify relationships both among the 3 organisational perception constructs, and between these constructs and the 4 employee-assessed outcomes. Overall, employee-related outcomes of satisfaction and retention are improved by increases in Leadership and Support construct scores. Our findings corroborate the findings of Goddard *et al.* (1997, 1998, 2000) who highlight the importance of leadership in the UK National Health Service context, and Delaney and Huselid (1996) who reported positive associations between human resource management practices and performance measures. In addition, Brickley and Van Horn (2002) suggest that the strength of the relationship between leadership and employee satisfaction is stronger in non-profit hospitals, than in for-profit hospitals and other for-profit corporations, and Matías-Reche *et al.* (2009) highlight the importance of sound leadership structures that generally characterize market oriented organisations. The basic structure of the Leadership construct remained relatively constant over all 4 surveys, with the 2 rewards-related manifest survey variables maintaining the strongest loading. By contrast, the strongest loadings on the Support construct were related to discrimination in 1997 and 2001, but this loading shifted to relationship-related variables ('respect' and 'teamwork') in the last 2 survey years in the study

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(with ‘differences valued’ maintaining a high loading, as well). This corroborates with Kirkman and Sapiro (2001) who report that employees can resist management decisions which are against their cultural values, as evidenced from a multi-country survey of self-managed work teams. Finally, the Resources construct also showed important changes in the strongest loadings: items related to customer focus were most strongly associated with Resources in 1997 and 2001, while employee-related items of safety and informational/equipment resources were prominent in 2004 and 2006.

Addressing Aim 2, it was possible to identify the outcome most in need of targeted intervention. Employee-perceived quality of service has the lowest overall strength of association with the organisational perception latent constructs and is also a primary focus for VHA quality improvement interventions. To identify the components of employee organisational experience most useful for intervention, the SEM analyses suggest two possible complementary approaches:

- Since Resources is most strongly related to employee estimates of quality of care, items and domains associated with this construct should be bolstered, including: focus on employee safety, increased availability of informational and material resources necessary for employees to do their work, and structural improvements to patient access to information.
- Because Leadership and Support show a substantially smaller relationship to quality than Resources, focus on improving their primary indicators could increase their current contribution to quality. An added benefit to this

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is that these two latent constructs are strong contributors to employee satisfaction and retention; improvements in components of these constructs could lead to improvements in both employee- and patient-related outcomes.

Addressing Aim 3, continuing measurement of these manifest items most strongly related to the 3 underlying organisational perception constructs will thus also provide quantifiable markers of intervention success or failure. For example, from Table III, the unchanged primacy of rewards items on Leadership across all the four surveys clearly speaks of these being appropriate foci for interventions and indicators of intervention effectiveness.⁸ Likewise, the survey items most strongly related to the other latent constructs would naturally serve as measurable indicators of intervention success.

Addressing Aim 4, to examine the changes over time, the above relationships remained relatively stable between 1997 and 2001 surveys, and between 2004 and 2006 surveys. However, there were substantial changes in measures of association between the 2001 and 2004 surveys. There are several possible reasons for these changes: first, they may reflect a true change in the covariance structure of the manifest and latent constructs related to overall VHA system changes over this time period. Second, the wording of most items changed between 2001 and 2004, with

⁸ In fact, ongoing VHA intervention programs, mediated since 2001 through the National Center for Organisational Development (NCOD) in Cincinnati, have often found these areas to be among the primary concerns of the hospitals with which NCOD works (Osatuke *et al.*, 2009).

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phrases added to the items making them more specific to workgroup climate. Over this time period, mean item scores increased, probably representing a combination of the wording changes and a general increase in positive appraisal by employees (see below). Third, there may be other unmeasured confounders that changed the relationships in 2004 and 2006, compared to the earlier surveys. Finally, temporal changes may be due to a combination of the above mentioned 3 reasons.

In support of the first possibility, there were system-wide changes in VHA and in the larger Department of Veterans Affairs. The period before 2001 reflects the decentralization philosophy and managed competition with power distribution to the facility and regional organisational structures. Major changes in some organisational elements, e.g. information technology and fiscal and human resources management, reflected a tendency towards centralization after 2001. Importantly, organizations are always changing, driven by multiple competing issues, some local (nursing shortages, for example), and some national (such as the national redistribution of the budget under the Veterans Equitable Readjustment Act model that created dramatic differences between winners and losers (Yaisawarng and Burgess, 2006)). Other drivers include differences in geographical location and status as early and late adopters of innovation. Until more data on the organizational changes at the individual facility level are available, the authors consider it premature to interpret the causes for changes in model structure.

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In addition, because of the recognized strong relationships between employee satisfaction, patient safety, and quality of care (Warren *et al.*, 2007), VHA implemented a Network Director Performance measure based on employee satisfaction beginning in 2004, thus increasing attention to AES results. This increased emphasis was accompanied by greater system attention to facility needs and feedback to facilities, with increased employee awareness that AES results materially affect working conditions. This awareness, combined with improvements in the AES administration procedures, (better coordination, communication and marketing, as well as increased availability and use of the more convenient web option), has probably influenced the steadily rising response rate after 2001. But the change in mode towards web-based may also have affected covariance structures by changing the demographic distribution of the respondent sample; certain groups have less comfort with or access to computers (Mohr *et al.*, 2010).

The second possibility, change in covariance structure due to wording changes in the items, is also likely. This wording change was associated with an overall increase in mean item scores from 2001 to 2004. Two of the items did not have wording changes, and their average change was 0.2 of an interval on the 5-point Likert response scale, compared to an average of 0.43 for the items that were changed. If these items are representative, about half the item score increases from 2001 to 2004 can be attributed to the wording change, but the other half evidently represents system-wide improvements in perceptions. Change in primary loadings

Change in association between workplace traits and job outcomes over time on the Support latent variable, from discrimination to teamwork and respect, may reflect a changed respondent focus from overall hospital culture to immediate workgroup culture, characterized by this increased primacy of teamwork and respect. . Complementing this interpretation, and suggesting a combination of causes including wording change and VHA organisational change, the 2004-2006 period also marks the introduction of a interventions focused on Civility (Osatuke *et al.*, 2009).

Finally, the superbeta appears to be a better measure for understanding the full web of interrelationships, as well as for comparing the strength and direction of influences. The superbeta, by incorporating more of the complex relationships among variables provides a more accurate estimate of the association, when considered in conjunction with total effect, than the total effect alone.

A primary weakness of this study is the complete reliance on self-report responses by employees, with possibilities for information bias, as well as common-instrument bias (exposure and outcome being reported in the same instrument, with potential for reciprocal bias).⁹ A second weakness is the inability to identify and link individual respondents across the survey years (by design, due to the sensitive nature of many questions). Future analyses will link the surveys via hospital

⁹ Earlier cross-sectional analyses of 2001 AES data, utilizing both survey-reported and administrative sources of outcomes data (Warren *et al.*, 2007), found that intra-survey exposure/outcome relationships were somewhat stronger than those calculated between survey-based independent and administrative outcome variables. But the latter associations are strong and congruent with the intra-survey relationships.

Change in association between workplace traits and job outcomes over time identification, and include hospital characteristics as covariates (e.g., size, complexity, geographical location). Third, no demographic data, such as respondent age, gender, years in service, were included in the models as it was outside the scope of the objectives in this paper. SEM that includes demographic information has been shown to provide better fit (Das *et al.*, 2008). Fourth is the issue of missing responses in the surveys. In each year, a large proportion of all returned surveys was excluded from analysis due to partial missingness . This procedure could have biased the estimates if there were large differences in the percentage of missing values based on demographic groupings, job titles, etc. Although differences in percentage of missing values between demographic groups was relatively small for any given item, the effect is multiplicative over the 25 items, presenting the possibility of bias based in the exclusion of cases. Future analysis will explore less rigorous treatments of missing values, allowing them to be excluded pair-wise, to estimate the effect of differential case exclusion on the overall models. Fifth, a potential confounder of the longitudinal study is the substantial change in survey administration mode noted above. In 2003, NCOD administered a pilot designed to test how demographic and occupational characteristics affected response rate and drop-off rate, using an experimental design that randomly assigned workgroup members to one of the three response mode conditions (Nagy *et al.*, 2006). The highest response rate was for the paper-and-pencil mode. The IVR (Interactive Voice Response – telephone administered) mode had a significantly lower rate of completion and greater drop-off rate than either the internet or paper-and-pencil mode. Minorities and hourly employees were

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less likely to respond when assigned to modes other than paper-and-pencil. These findings suggest that the shift to mainly web-based surveys may have biased results towards the responses of employees who are comfortable with computers.

Although it is likely that many employees' computer literacy increased over this time period, due to VHA's reliance on multiple electronic record systems, this mode shift represents a potential confounder for which these analyses cannot be adjusted.

The primary strength of this investigation is the size of the 4 surveys, providing highly significant results in spite of partial missingness. Second, the longitudinal nature of the investigation allows identification of trends. Further analysis of the VHA surveys will advance our ability to understand the drivers of system performance, and help in monitoring and improving healthcare delivery in settings even outside the VHA system.

5 CONCLUSION

Using four full census surveys conducted by the Veterans Health Administration (VHA) in the United States (US) between 1997 and 2006, this investigation quantifies associations between health care employee perceptions of organisational characteristics with perceptions of organisational performance: two employee-related (satisfaction and turnover intention) and two patient care related (quality of care and patient satisfaction). The web of associations among the measures characterized by Structural Equation Modelling (SEM) changed somewhat over

Change in association between workplace traits and job outcomes over time, presumably in relation to changes in VHA policy emphases, changes in survey wording, and other unmeasured factors. The overall findings provide several policy implications:

1. Since employee-related outcomes of satisfaction and turnover intention were primarily improved by the constructs of Leadership and Support, interventions designed to improve employees' experience of these constructs are indicated -
 - a. Primary attention should be paid to the predictability and fairness of the rewards system — the survey elements that are consistently most strongly associated with perceptions of Leadership;
 - b. Perceptions of Support could most be improved by interventions targeting both workgroup respect and teamwork, with attention also paid to improving acceptance of differences.
2. Since employee-assessed patient-related outcomes of satisfaction and quality of care were most strongly related to the construct of Resources, interventions should target the primary components of this construct: employee safety, access to informational and material resources, with continued attention to patient-focused policies and procedures.

The VHA has been engaging in national initiatives that support these approaches. But the workgroup-specific wording of the survey items suggests that the primary determinants of appropriate intervention foci and techniques should be determined at the local hospital level.

ACKNOWLEDGMENT

We wish to thank the US Department of Veterans Affairs, Veterans Health Administration and especially the Organisational Assessment Sub-Committee of the Human Resources Committee for access to its survey data. We are also highly indebted to the referees and an Associate Editor for their critique of this work, which helped us improve this paper greatly. We thank Prof. Steve Koch for very useful discussions. The conclusions in this paper are entirely those of the authors and do not necessarily represent the views of the VA. No conflict of interest exists among the authors.

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APPENDIX A

For the i^{th} individual, let y_{ij} denote the response to the manifest variables for $j = 1, \dots, 21$, and the outcome variables for $j = 22, \dots, 25$. For the proposed SEM, for $j = 1, 2$, $y_{ij} = \beta_{j_1} F_{i1} + e_{ij}$; for $j = 3, 4$, $y_{ij} = \beta_{j_2} F_{i2} + e_{ij}$; and for $j = 5, 6$ $y_{ij} = \beta_{j_3} F_{i3} + e_{ij}$. For $j = 7, \dots, 21$, $y_{ij} = \beta_{j_1} F_{i1} + \beta_{j_2} F_{i2} + \beta_{j_3} F_{i3} + e_{ij}$. For the outcome variables, $j = 22, \dots, 25$, $y_{ij} = \beta_{j_1} F_{i1} + \beta_{j_2} F_{i2} + \beta_{j_3} F_{i3} + \beta_{j_4} F_{i4} + e_{ij}$. For the structural part of the model, $F_{i1} = \delta_{i1} F_{i2} + \varepsilon_{i1}$; $F_{i3} = \delta_{i2} F_{i1} + \delta_{i3} F_{i2} + \varepsilon_{i2}$. For the errors, we assume

$$e_{ij} \sim N(0, \sigma_j^2), j = 1, \dots, 25; \varepsilon_{ij} \sim N(0, \sigma_j^{*2}); \text{Var}(F_{i2}) = \text{Var}(F_{i4}) = 1.$$

Here, F_{i1} , F_{i2} , F_{i3} and F_{i4} correspond to the latent variables Leadership, Support, Resources and Outcome, respectively. Since Support and Outcome are exogenous,

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their error variance is 1. e_{ij} and ε_{ij} correspond to the errors in the measurement part and the structural part of the SEM, respectively, and they are assumed to be independent of each other and also independent of F_{i4} .

APPENDIX B

A simulated example to illustrate a case where total effect=0, but superbeta≠0.

Consider a model that has 3 latent variables and one outcome variable y depicted as follows:

[Figure 3 about here]

Usual assumptions for the error terms are assumed. Observe that there is no directional connection between Latent 3 and y, and hence corresponding total effect is zero. However, the corresponding superbeta calculation is as follows:

$$\begin{aligned} \text{Superbeta}(y, \text{Latent 3}) &= \frac{\text{Cov}(y, \text{Latent 3})}{\text{Var}(\text{Latent 3})} \\ &= \frac{\beta_1(\gamma_1\gamma_2 + \gamma_3(\gamma_1^2 + 1))}{\gamma_1^2 + \gamma_3^2(\gamma_1^2 + 1) + 2\gamma_1\gamma_2\gamma_3 + 1} \end{aligned}$$

Note that this is not necessarily zero.

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Table I: Percentages of Respondents using Survey Modalities

Method	1997	2001	2004	2006
Paper	100%	100%	10.4%	6%
Interactive Voice Response	NA	NA	13.1%	8.4%
Web	NA	NA	76.5%	85.6%

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Table II: Response rates for the 1997, 2001, 2004 and 2006 VHA surveys

National Results	1997	2001	2004	2006
Respondents	112,661	74,662	110,664	149,628
Employee Count	204,124	207,110	212,877	213,280
Response Rate	55.2%	36.5%	51.9%	70.2%

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Table III: Factor loading for VHA AES analysis

Manifest variable	1997			2001			2004			2006		
	Leadership	Support	Resources	Leadership	Support	Resources	Leadership	Support	Resources	Leadership	Support	Resources
Pay satisfaction	0.05	0.46	0.13	0.41	0.14	0.07	0.31	0.08	0.36	0.46	0.03	0.29
Fair rewards	0.77	0.26	0.10	0.77	0.19	0.11	0.80	0.33	0.11	0.70	0.48	0.06
Rewards for service	0.71	0.05	0.24	0.70	0.04	0.18	0.75	0.26	0.23	0.74	0.34	0.17
Skill development	0.51	0.41	0.23	0.66	0.13	0.24	0.71	0.31	0.30	0.70	0.36	0.26
Innovation	0.55	0.12	0.48	0.65	0.10	0.35	0.67	0.31	0.37	0.70	0.35	0.31
Customer focus	0.27	0.06	0.75	0.18	0.06	0.79	0.48	0.24	0.59	0.55	0.22	0.54
Customers informed	0.16	0.11	0.69	0.10	0.11	0.77	0.46	0.27	0.51	0.48	0.27	0.48
Manager goals	0.60	0.24	0.40	0.63	0.15	0.34	0.70	0.30	0.37	0.65	0.41	0.30
Respect	0.41	0.47	0.25	0.54	0.36	0.21	0.22	0.84	0.14	0.19	0.79	0.24
Conflict resolution	0.57	0.47	0.21	0.59	0.37	0.17	0.40	0.77	0.17	0.37	0.73	0.22
Employee involvement	0.46	0.26	0.50	0.58	0.16	0.41	0.38	0.62	0.35	0.40	0.54	0.39
Co worker skills	0.12	0.40	0.55	0.33	0.21	0.51	0.15	0.62	0.40	0.10	0.44	0.61
Employee resources	0.09	0.38	0.55	0.29	0.15	0.51	0.16	0.2	0.79	0.25	0.19	0.75
Safety	0.12	0.51	0.43	0.22	0.32	0.46	0.18	0.3	0.71	0.24	0.32	0.65
Work/family balance	0.44	0.47	0.19	0.49	0.34	0.18	0.52	0.46	0.32	0.44	0.55	0.28
Teamwork	0.45	0.42	0.32	0.58	0.30	0.24	0.32	0.78	0.22	0.24	0.75	0.30
Planning evaluation	0.38	0.30	0.46	0.18	0.28	0.36	0.65	0.40	0.29	0.53	0.54	0.28
No discrimination	0.28	0.70	0.11	0.19	0.83	0.16	0.41	0.54	0.27	0.30	0.63	0.28
Differences valued	0.27	0.72	0.18	0.22	0.84	0.18	0.44	0.71	0.23	0.31	0.75	0.26
Different background	0.39	0.68	0.17	0.25	0.72	0.19	0.53	0.59	0.26	0.43	0.65	0.22
Supervisor support	0.66	0.44	0.09	0.59	0.36	0.13	0.71	0.41	0.17	0.57	0.52	0.11

Note: The bold-italicised font numbers correspond to the two largest loadings for the corresponding factor.

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Table IV: Goodness of fit measures for the 4 AES based on Figure 1

Fit indices	1997	2001	2004	2006
Goodness of Fit (GFI)	0.9517	0.9429	0.9063	0.904
GFI adjusted for degrees of freedom (AGIF)	0.9318	0.9193	0.8683	0.8643
Chi-square	39857.89	31193.79	83496.5	123265.1
Chi-square/ DF	173.2952	135.6252	363.0283	535.9352
DF	230	230	230	230
Akaike's information criterion	39397.89	30733.79	83036.5	122805.1
Schwarz's Bayesian criterion	37301.12	28725.44	80911.68	120593.6
Nonnormed coefficient	0.9269	0.9275	0.9158	0.92
Hoelters critical N	451	393	244	241

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Table V: Effect measures between outcome variables and latent based on Figure 1

Manifest	Direct effect			Total effect			Standardized Superbeta and CI		
	Leadership	Support	Resources	Leadership	Support	Resources	Leadership	Support	Resources
1997									
Retention	0.06	0.04	0.05	0.08	0.13	0.05	0.301	0.265	0.279
Customer satisfaction	-0.01	0.20	0.35	0.12	0.44	0.35	(0.29, 0.31)	(0.26, 0.27)	(0.27, 0.29)
Employee satisfaction	0.23	0.21	0.18	0.30	0.53	0.18	0.382	0.450	0.564
Quality	-0.01	0.28	0.17	0.06	0.40	0.17	(0.37, 0.39)	(0.44, 0.46)	(0.56, 0.57)
							0.534	0.500	0.487
							(0.53, 0.54)	(0.49, 0.51)	(0.48, 0.49)
							0.331	0.436	0.406
							(0.32, 0.34)	(0.43, 0.44)	(0.40, 0.41)
2001									
Retention	0.15	0.12	0.03	0.32	0.37	0.03	0.314	0.247	0.206
Customer satisfaction	0.15	-0.06	0.38	0.21	0.35	0.38	(0.31, 0.32)	(0.24, 0.26)	(0.20, 0.22)
Employee satisfaction	0.45	0.21	0.14	0.53	0.46	0.14	0.396	0.375	0.583
Quality	0.28	0.37	0.18	0.28	0.37	0.18	(0.39, 0.40)	(0.37, 0.38)	(0.58, 0.59)
							0.614	0.408	0.456
							(0.61, 0.62)	(0.40, 0.42)	(0.45, 0.46)
							0.464	0.383	0.438
							(0.46, 0.47)	(0.37, 0.39)	(0.43, 0.45)
2004									
Retention	0.16	0.28	0.04	0.17	0.64	0.04	0.484	0.478	0.412
Customer satisfaction	-0.12	0.20	0.32	-0.06	0.38	0.32	(0.48, 0.49)	(0.47, 0.48)	(0.41, 0.42)
Employee satisfaction	0.10	0.21	0.21	0.14	0.66	0.21	0.341	0.423	0.534
Quality	-0.07	0.08	0.2	-0.03	0.22	0.20	(0.33, 0.35)	(0.42, 0.43)	(0.53, 0.54)
							0.598	0.610	0.612
							(0.59, 0.61)	(0.60, 0.62)	(0.60, 0.62)
							0.235	0.286	0.379
							(0.23, 0.24)	(0.28, 0.29)	(0.37, 0.39)
2006									
Retention	0.19	0.24	0.07	0.22	0.66	0.07	0.517	0.502	0.462
Customer satisfaction	-0.14	0.20	0.36	-0.01	0.44	0.36	(0.51, 0.52)	(0.50, 0.51)	(0.46, 0.47)
Employee satisfaction	0.12	0.17	0.24	0.21	0.70	0.24	0.395	0.463	0.578
Quality	-0.10	0.09	0.23	-0.01	0.25	0.23	(0.39, 0.40)	(0.46, 0.47)	(0.57, 0.58)
							0.629	0.619	0.648
							(0.62, 0.63)	(0.61, 0.62)	(0.64, 0.65)
							0.266	0.313	0.408
							(0.26, 0.27)	(0.31, 0.32)	(0.40, 0.41)