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Organizational culture in airworthiness management programmes: extending an existing measurement model

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All civil and private aircraft are required to comply with the airworthiness standards set by their national airworthiness authority and throughout their operational life must be in a condition of safe operation. Aviation accident data shows that over 20% of all fatal accidents in aviation are due to airworthiness issues, specifically aircraft mechanical failures. Ultimately it is the responsibility of each registered operator to ensure that their aircraft remain in a condition of safe operation, and this is done through both effective management of airworthiness activities and the effective programme governance of safety outcomes. Typically, the projects within these airworthiness management programmes are focused on acquiring, modifying and maintaining the aircraft as a capability supporting the business. Programme governance provides the structure through which the goals and objectives of airworthiness programmes are set along with the means of attaining them. Whilst the principal causes of failures in many programmes can be traced to inadequate programme governance, many of the failures in large-scale projects can have their root causes in the organizational culture and more specifically in the organizational processes related to decision-making. This paper examines the primary theme of project and programme-based enterprises, and introduces a model for measuring organizational culture in airworthiness management programmes using measures drawn from 211 respondents in Australian airline programmes. The paper describes the theoretical perspectives applied to modifying an original model to specifically focus it on measuring the organizational culture of programmes for managing airworthiness; identifying the most important factors needed to explain the relationship between the measures collected, and providing a description of the nature of these factors. The paper concludes by identifying a model that best describes the organizational culture data collected from seven airworthiness management programmes.

Keywords: Continuing airworthiness, organizational culture, programme management.

Introduction

The main theories used to describe governance are agency and shareholder theories, stakeholder theory, transaction cost economics (TCE) and stewardship theory (Mallin, 2010). As governance applies to portfolios, programmes and projects, the theoretical continuum ranges from shareholder to stakeholder; with the agency, and TCE theories applying within this continuum (Müller, 2009). Stakeholder theory adopts a broad perspective of governance, suggesting that sustainable value creation is better achieved when business goals are developed by balancing potentially conflicting interests of stakeholders. During their life cycle, most projects experience times when the interests of the business shareholders are the dominant interest, and in these circumstances the fundamentals of the stakeholder theory still applies to programme governance as the shareholder is a stakeholder and all stakeholder interests have to be kept in alignment over time (Freeman, 2004). TCE supports the use of different governance structures for projects based upon their varying needs to buy/contract an element of the project or to make that element within the project. Whereas, agency theory is strongly related to shareholder theory with the project sponsor as principal and the project manager as agent (Müller, 2009).

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The focus of this paper looks at programme governance largely from the stakeholder theory perspective of realizing the full benefits for the organization; ensuring that decision-making and project activities are focused on the business goals, stakeholder requirements and effective risk and opportunity management (PMI, 2008). Specifically, how a programme assures that the safety goals are achieved.

In 2004, a survey of 200 international airlines identified that most adopted a balanced approach to measuring performance; financial, operational, quality, environment, customer and safety goals. However, all but a few experienced difficulty in keeping all stakeholder requirements moving in the same direction, as most airlines were primarily focused on the shareholders interests associated with financial and operational performance (Fry and Humphreys, 2004).

Ultimately, it is the responsibility of an airline to ensure that their aircraft remain in a condition of safe operation, and this is done by effectively managing programmes that maintain aircraft configuration baselines, and deliver the safety and regulatory compliance benefits mandated by national airworthiness authorities. These programmes are designed to manage a group of related projects and elements of routine operations to deliver the benefit of continuing airworthiness (ICAO, 2007) of the airline's aircraft, while at the same time, keeping the other business goals in balance. Typically, the projects within these programmes are focused on acquiring, modifying and maintaining the aircraft to provide an assured capability supporting the business and consist of the following:

- Introduction of new aircraft types.
- Import and export of aircraft.
- Aircraft modifications campaigns.
- Introduction of major changes such as new ports or routes, cabin configurations, ground support equipment, technology, maintenance providers, engineering providers, type of operations (freight, charter or regular transport) and regulations.
- Heavy maintenance visits with defined resources, schedule and a unique scope of work that includes scheduled maintenance, special inspections, defect rectifications and modifications.

There have been significant project failures in aviation history that are linked to the organizational culture of teams and specifically to the quality of decisions being made by project team members. One of the more noteworthy was the Challenger accident in 1986, which was linked to a normalization of increased risk levels in the NASA decision-making process that led to the destruction of that space shuttle and resultant loss of life of the crew members (Vaughan, 1996). More recently, the catastrophic failure of a Rolls Royce Trent 900 engine in November 2010 which caused a near disaster involving a Qantas A380 aircraft with 466 persons on board, was linked to the Rolls Royce decision-making processes and their risk assessment of a known manufacturing defect which was subsequently identified as the primary cause of the engine failure (ATSB, 2011). Other significant large-scale project failures where the role of the organizational culture in systemic biases have led to bad project decisions and in turn project failures include the Airbus 380 $6 billion loom redesign, and the breakdown of the Denver Airport baggage handling system which delivered a $60 million per year liability for United Airlines arising from overconfidence with implementing untried technologies (Shore, 2008). In reality, many routine project decisions are judgement decisions (Strutt *et al.*, 2006) and these judgements are influenced by both the quality of available information and the decision criteria used by team members when making their judgements.

The purpose of this paper is to produce a better understanding about the organizational cultures in programmes responsible for airworthiness in airlines; specifically extending the Denison organizational culture model with the addition of an assurance cultural trait. The paper reports on a measurement model that best describes the programme organizational culture using data collected from seven airworthiness management programmes. These research results form part of a larger research project which is examining the impacts of organizational culture and decision-making on programme assurance.

Programme organization

Organizations generally arrange themselves in structures that represent a unique solution to the forces working on the organization and the problems they face (Mintzberg, 1991). While having to deliver similar benefits for their parent organizations, the programmes studied in this research adopted different organizational structures, varying along the continuum of high levels of authority and control over resources to a programme with limited direct authority and reliant upon the coordination of the efforts of others in the organization.

Operating in a governance environment underpinned predominantly by stakeholder theory, the studied programmes were all striving to achieve similar programme outcomes, working within different programme structures, and consequently each programme developed a unique solution to address the dynamic forces acting

on the programme. These forces included the need to; rationalize and standardize work to achieve consistency, align the various activities to achieve a common purpose or mission, develop skills and knowledge so individuals can maximize their involvement, and concentrate the programme efforts on the customer while initiating and managing change for the benefit of the customer and the organization (Mintzberg, 1991; Denison and Neale, 1996). The programme governance also requires that; programme objectives are met, and accurate information is made available about the efficiency, effectiveness and compliance of the programme. In each programme, the concurrency of these forces is held in balance by a unique pattern of attitudes, practices and behaviours, the organizational culture.

Organizational culture

Three of the most commonly cited perspectives on organizational culture are gained from the fields of sociology, anthropology and business management (Ouchi and Wilkins, 1985). According to Cameron and Quinn (2006), two primary approaches for understanding organizational culture have emerged from these perspectives; culture which comes from the collective behaviour of members from the organization, and culture found in the individual interpretations and cognitions. These two perspectives are known, respectively, as functional and semiotic approaches. The functional approach is quantitative and relies on being able to empirically measure the differences between cultures, whereas the semiotic approach is qualitative and relies on gaining understanding from the signs and symbolism within an organization. The broader research project, which this research is part of, uses both the quantitative and qualitative approaches to understanding the culture of the studied programmes. This paper focuses on the development of the measurement model used in the quantitative research on organizational culture. This quantitative approach views culture as an independent, explanatory variable (Ouchi and Wilkins, 1985), that can be studied as a series of comparative traits or dimensions.

Schein (2004, p. 17) defines organizational culture as

a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems.

Guldenmund (2000, p. 251) performed an extensive review of literature on safety cultures and concluded that 'in the way Schein conceives and defines (organisational) culture, there is no need for a specific definition (of organisational culture) for safety'. Focusing on the safety culture itself, Guldenmund (2000, p. 251) provided the following definition of it; 'those aspects of the organisational culture which will impact on attitudes and behaviour related to increasing or decreasing risk'.

Culture in programme management organizations

A project manager faces two immediate challenges when considering the desired culture or character of the project (Andersen, 2003);

- Creating the desired results-orientated organizational culture, and
- Understanding the interfaces with the programme's organizational culture.

Reinforcing Andersen's research, a recent study of 146 professionals working in the Hong Kong construction industry (Cheung *et al.*, 2011) highlighted that participating businesses exhibited a strong results-focused culture. Specifically, the study identified that the two most highly ranked organizational culture factors for projects in that industry were; goal setting and accomplishment, and team orientation.

The Project Management Institute (PMBoK, 2008) advises project managers to understand the different cultures of their stakeholders as the nature of the project culture can impact on decision-making, pace of work and the tendency to react without appropriate planning. Specific research involving 86 project professionals from various US service and manufacturing organizations, identified that a project organizational culture which exhibits high cohesion, collegiality in decision-making, and has a sense of identity, can significantly influence project effectiveness and efficiency (Yazici, 2009).

Extending the investigation into the relationships between organizational culture and the business and its projects, research by numerous authors confirmed that the broader business or programme culture impacts the project culture (Elmes & Wilemon, 1991; Gray, 2001; Andersen, 2003; Morrison *et al.*, 2008; Kerzner, 2009).

Existing organizational culture models

Cameron and Quinn developed a framework that identified four categories of organizations using a combination of two dimensions, flexibility/stability and external/internal focus. This became known as the

Competing Values Model and uses the dimensions of change/stability and external/internal focus to measure organizational culture (Cameron and Quinn, 2006, p. 46).

In 1990, Denison published 'Corporate Culture and Organizational Effectiveness' that contained the Denison organizational culture model which used some of the same dimensions as the Cameron and Quinn 'Competing Values Framework'. For example, both describe culture in terms of four characteristics, 'flexible', 'stable', 'internal' and 'external', to describe organizational culture. The Denison Model emphasizes the importance of 'mission', and Cameron and Quinn describe a dimension of 'rational goals' that takes a similar position in their model. By taking a more holistic perspective on culture that includes strategic fit and adaptability, a more complete description of the relationship between the organizational culture and performance was developed (Kotter and Heskett, 1992; Denison and Neale, 1996; Denison, 2006). The organizational culture model used by Denison measures four key cultural traits; involvement, adaptability, consistency and mission. Each trait has three indices each measured with 5 variables for a total number of 60 variables. The key cultural traits are explained in the following paragraphs (Denison *et al.*, 2007):

- Involvement is measured by; empowerment of team members to manage their own work, team orientation when working towards common goals, and capability development of individuals in order to meet business needs.
- Adaptability is measured by; creating change to react and anticipate future changes, customer focus to anticipate customers need, organizational learning to encourage innovation, build knowledge and capability.
- Consistency is measured by; core values to provide a clear set of expectations, agreement of team members on critical issues, and coordination and integration of teams in order to achieve the common goals of the organization.
- Mission is measured by; strategic direction of the organization, vision of the future state for the organization, and goals and objectives to provide team members with a clear direction in their work.

The Denison model has been used extensively to link organizational culture with company effectiveness; specifically profitability and growth, the balance between short term (annual) performances versus the sustainability of the business. There are many similarities with this balance of performance measurement and that needed for assessing both the near and long-term programme performance. The quadrant view of the key cultural traits is also very relevant tothe programme context and the objectives of this research. Specifically, programmes deliver outcomes but projects deliver outputs, programme management is concerned with doing the right projects; successful programmes deliver long-term improvements to an organization usually identified through benefits. Programmes are focused on delivering change on behalf of the organization, assuring project success as well as delivering more strategic outcomes. However, some programmes may see short-term performance as being more important than achieving the strategic benefits, so the broader research project is interested in measuring the different view on how the organizational culture impacts programme performance.

Denison organizational culture model observed variables

The Denison culture model measures four key cultural traits using observed variables, posed as questions on a Likert scale of 1–5. These questions were originally obtained from top executives in over 750 organizations and have been refined into the Denison Organizational Culture Model Survey which has been examined using reliability analysis and confirmatory factor analysis (CFA) data from over 160 organizations and found to be within acceptable levels for consistency within the scales (Denison, 2012). The questions are structured to avoid being superficial; to effectively link these variables with organizational effectiveness the questions capture the contextualized perception as well as the top-down interpretation (Denison and Mishra, 1995).

The variables and key cultural traits from the Denison model were used as the basis to construct the factor model tested and subsequently extended to best accommodate the organizational culture within the programmes studied.

Decision-making in organizational culture

Drawing upon the research on national culture, Hofstede (Hofstede and Hofstede, 2005) identified that two questions must be answered when organizing:

- Who has the power to decide what? (Power distance within the organization)
- What rules or procedures are to be used? (The degree which uncertainty is avoided)

Generally, organizations make choices in response to encountering a problem; using standard operating rules, making a series of decisions or choices by evaluating alternatives against explicit or implied goals. These organizational goals are a function of the stated or

implied goal, and the organization's experience with that goal, either direct or learned from other organizations over time. The standard operating rules employed follow three main principles (Cyert and March, 1992):

- Uncertainty avoidance procedures which are aimed at avoiding future negative consequences from events; for example, monitoring the environment or the business outputs to identify hazards which are treated with standardized decision rules.
- Maintaining the rules; by strict adherence to processes and associated decision rules that have proven to work over time.
- Using policy or simple rules, which rely on individual judgement, to provide flexibility for the organization. Expert judgement, as described by PMI (PMBoK, 2008), is based upon the rapid heuristics (intuition) decision processes, conversely novices may have to rely heavily upon the more analytical decision processes involving standards or rules (Evans, 2007, p. 132).

Within the ideal project environment, problems and solutions are assumed to be relatively stable, allowing linear and well-structured decisions, within a climate of clear goals and targets, identified schedules, fixed end products and clear management frameworks. Management of project changes, arising from either external or internal sources, makes the environment more complicated and dynamic. During the course of the project the stakeholders can contribute their own problems and solutions, whilst internal to the project, new scope and project performance are all sources of change (Bruijn et al., 2002). In reality, many organizational forces disturb this ideal environment:

- Poor alignment of the culture with the project strategic boundaries;
- Key information is not shared and not made available to decision-makers;
- Change is not anticipated and risks mature in an uncontrolled manner and
- Non-homogenous values create inconsistencies in decision-making, judgements and behaviours.

Governance and organizational culture

Governance involves a set of relationships between a company's management, its board, its shareholders and other stakeholders. Corporate governance also provides the structure through which the objectives of the organisation are set, the means of attaining those objectives and monitoring performance. (OECD, 2004, p. 11)

More specifically programme governance 'ensures decision-making and delivery management activities are focused on achieving program goals in a consistent manner, addressing appropriate risks, and fulfilling stakeholder requirements' (PMI, 2008, p. 243). Both definitions have a common intent for governance as ensuring that a broad set of requirements and interests are fully addressed by the management systems when achieving the programme goals and objectives. Furthermore, the PMI definition indicates that the programme culture also needs to support the decision-making and delivery management activities.

As a key part of programme governance in this study, assurance represents the behaviours and assumptions of organization members impacting on programme decisions about the efficiency, effectiveness and compliance of the delivery management systems in the programme. Core to assurance is making current and accurate information available to stakeholders for decision-making and the achievement of programme objectives.

To better understand the organizational culture of programmes charged with the objective to assure continuing airworthiness, a cultural measurement model that includes assurance as a factor is proposed and analysed to produce the best measurement model for the studied programmes.

Method

Measurement of programme organizational culture

Airline performance can be measured against the objectives of financial, operational and safety performance (Fry and Humphreys, 2004). The context for the research is the continuing airworthiness management programme within the airline, which contributes to the airline safety objective. These programmes are designed to deliver safety-related outcomes, and while the effective management of resources is critical for programme success, financial performance is not the primary measure of success for these safety-related programmes. The seven programmes all had the common goal of ensuring aircraft remained in a condition for safe operation.

For the purpose of modelling, the organizational culture in these airworthiness management programmes, Schein's (2004) definition of culture was accepted and the Denison comparative culture model, which uses a competing values framework, was extended to define the cultural traits in programmes: how the programme makes decisions about performance, how the programme objectives are made relevant to all staff,

how collaboration occurs to solve programme problems, how the programme learns and improves, and how the teams deliver results and programme outcomes.

Previous research (Coffey, 2010; Coffey and Willar, 2010) has identified that the Denison model is an acceptable model for measuring the internal cultural forces within an organization. The model also collects data that can be used to determine how decisions are being made within an organization.

However, this paper aims to identify a model that best describes the organizational culture for programmes managing continuing airworthiness and safety. In order to remove potential ambiguity regarding effectiveness questions for the survey respondents, the Denison model questions were tailored to specifically address the business programme goal; realization of aviation safety outcomes achieved through a programme of continuing airworthiness management activities and projects.

The Denison survey questions were modified:

- To clarify the context was the programme within the airline as the organization.
- To clarify the goals were related to the management of continuing airworthiness.
- To clarify the safety regulator was the customer.

Additional survey questions

The 72 survey questions used to gather the data consisted of 60 questions from the Denison organizational culture model (Denison and Neale, 1996), which were modified for the airworthiness management programme context. To better understand how the programme organizational culture impacted the goal realization,

12 additional assurance-related questions were structured to determine the agreement respondents had with the programme safety goals and how the organizational culture traits impacted the achievement of the safety goals. These 12 additional questions were developed around the following four key cultural traits within the Denison model discussed earlier in the paper:

- How does staff involvement affect the safety goals?
- How does consistency in the teams work affect the safety goals?
- How does adaptability affect the safety goals? and
- How does mission affect the safety goals?

The survey was answered by 211 individuals from seven Australian airline programmes with the responsibility for ensuring that all aircraft must, at any time during their operating life, remain in a condition of safe operation. The data were collected using a Likert scale of 1–5; strongly disagree, disagree, neutral, agree and strongly agree.

Using these survey results, a factor analysis was conducted to determine the model that best describes the programme organizational culture. The final measurement model obtained from the factor analysis is compared with the hypothesized model.

Survey process

The respondents were from a sector of the aviation industry which had been heavily shaped by a long term and consistent regulatory framework provided by the Australian Civil Aviation Safety Authority. All members of the seven programmes were given the opportunity to complete the survey, with approximately 40% completing the survey. The survey was completed by 211 individuals; 157 team members, 52 managers and 24 senior managers with 26% of responders providing additional written comments. All respondents completed the survey and submitted their response anonymously.

Results

Data collected

The potential skewness of the Likert data received from respondents was addressed by also seeking respondents to rate the effect that each group of questions had on achieving the safety goals. This provided a means of differentiating between two respondents who may rate the question at the same level on the Likert scale but differ in their view on the importance of the variable in achieving the safety goals.

Table 1 Initial input variables and factors for CFA

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Q1.1	Q2.1	Q3.1	Q4.1	Q1A
Q1.2	Q2.2	Q3.2	Q4.2	Q1B
Q1.3	Q2.3	Q3.3	Q4.3	Q1C
Q1.4	Q2.4	Q3.4	Q4.4	Q2A
Q1.5	Q2.5	Q3.5	Q4.5	Q2B
Q1.6	Q2.6	Q3.6	Q4.6	Q2C
Q1.7	Q2.7	Q3.7	Q4.7	Q3A
Q1.8	Q2.8	Q3.8	Q4.8	Q3B
Q1.9	Q2.9	Q3.9	Q4.9	Q3C
Q1.10	Q2.10	Q3.10	Q4.10	Q4A
Q1.11	Q2.11	Q3.11	Q4.11	Q4B
Q1.12	Q2.12	Q3.12	Q4.12	Q4C
Q1.13	Q2.13	Q3.13	Q4.13	
Q1.14	Q2.14	Q3.14	Q4.14	
Q1.15	Q2.15	Q3.15	Q4.15	

The responses to the survey questions are the model input or observed variables and were grouped into five categories or latent variables; four categories corresponded with the four key cultural traits in the Denison model; Factor 1 is involvement, Factor 2 is consistency, Factor 3 adaptability and Factor 4 is mission. The fifth category labelled assurance included the 12 additional questions. The five categories and their associated observed variables (Table 1) were used as the input factors in the factor analysis, creating the hypothesized model (Schreiber *et al.*, 2006).

The variables were evaluated using a CFA to determine how well the hypothesized model described the collected data from the 211 respondents in the seven programmes. The analysis investigated the extent of the interrelationships and covariance within the framework constructed by the hypothesized latent and observed variables. By both removing variables and adding covariance relationships between variables, a measurement model was created that best represents the latent variables and their constituent observed variables (Schreiber *et al.*, 2006).

Factor analysis of data

The resultant factors that best described the collected data were derived from the CFA and are shown in the following Measurement Model (Figure 1). Compared with the hypothesized model which explained 64.9% of variance in the data, the final measurement model explained 74.9% of variance with a goodness of fit index of 0.733 and comparative fit index (CFI) of 0.874. A summary of the final five factors of the CFA and the associated observed variables is included in Table 2.

Reliability statistics for model factors

The Cronbach's alpha figures for each of the CFA factors are provided in Table 3. The results show

strong internal consistency for the model, with all factors showing Cronbach's alpha figures greater than 0.8 (George and Mallery, 2011).

Comparison of programme organizational culture CFA and Denison model

The following paragraphs compare the Denison Model key cultural traits with the final CFA factors (Factors 1–5) derived from the CFA.

CFA Factor 1

The input variables used for Factor 1 are questions related to empowerment, the team orientation, and capability development; these correspond with the Denison model key cultural trait of involvement. The final variables in Factor 1 showed strong covariance between questions related to the team orientation and capability development; the input variables related to empowerment did not show a relationship with the other variables in the proposed model. The CFA Factor 1 variables are focused on how teams work together to solve problems, and the factor is labelled team development.

CFA Factor 2

The input variables used for Factor 2 are questions related to values, agreement and integration; these align with the consistency cultural trait in the Denison model. The final variables in Factor 2 showed strong covariance across the range of questions related to values, agreement and integration in the Denison model. The CFA Factor 2 variables are focused on how the programme delivers results, and the factor is labelled consistency.

CFA Factor 3

The input variables used for Factor 3 are questions related to creating change, customer focus and organizational learning; these correspond with the adaptability cultural trait in the Denison model. The final

Table 2 Final measurement model (CFA) factors and variables

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Q1.6	Q2.1	Q3.3	Q4.2	Q1C
Q1.7	Q2.3	Q3.5	Q4.3	Q2A
Q1.8	Q2.5	Q3.10	Q4.4	Q2C
Q1.12	Q2.7	Q3.11	Q4.5	Q3A
Q1.13	Q2.9	Q3.12	Q4.6	Q3C
	Q2.10	Q3.13	Q4.7	Q4C
	Q2.11		Q4.8	Q1.2
	Q2.12		Q4.10	Q1.3
	Q2.15		Q4.11	Q1.11
			Q4.9	
			Q4.13	

Table 3 CFA factor reliability values

CFA factor	Factor name	Cronbach's α
1	Team development	.896
2	Consistency	.941
3	Change management	.905
4	Strategic alignment	.950
5	Assurance	.907
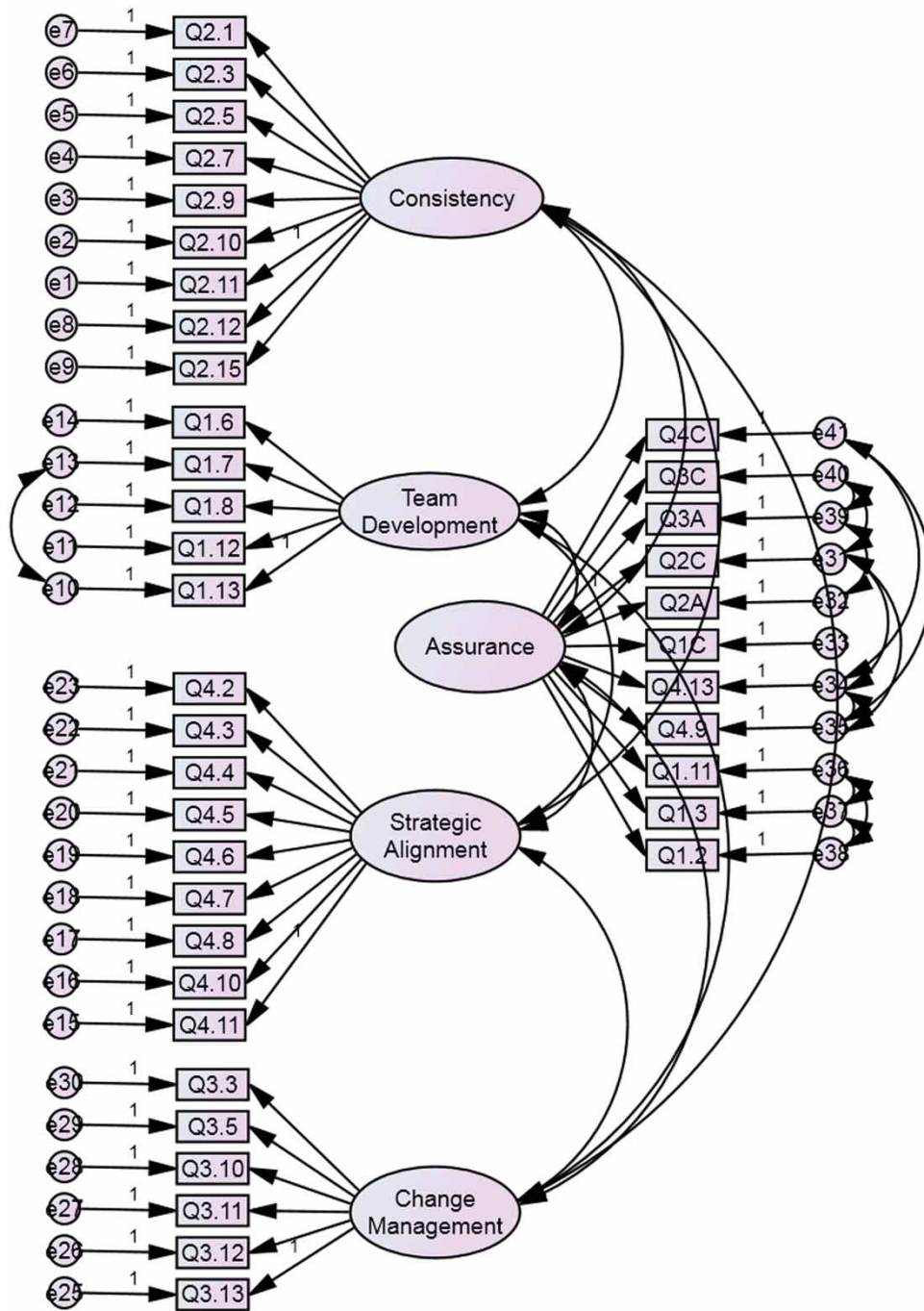
Figure 1 Measurement model (CFA) for programme organizational culture

variables in Factor 3 showed strong covariance between questions related to creating change and organizational learning; the input variables related to customer focus did not show a relationship with the other variables in the proposed model. The CFA Factor 3 variables are focused on how the programme learns and improves, and this factor is labelled change management.

CFA Factor 4

The input variables used for Factor 4 are questions related to strategic direction, goals and vision; these correspond with the mission cultural trait in the Denison model. The final variables in Factor 4 showed strong covariance across questions related to the strategic direction and the programme goals; the input variables related to vision did not show a relationship with the

other variables in the proposed model. The CFA Factor 4 variables are focused on how the programme goals are made relevant to team members, and the factor is labelled strategic alignment.

CFA Factor 5

The input variables used for Factor 5 are the 12 additional assurance-related questions introduced previously as 'additional survey questions'. Six of the original 12 questions were deleted from the measurement model and the final variables used in Factor 5 also included five variables transferred from other Factors. The final variables used in Factor 5 showed a strong covariance across questions related to decision-making about the programme performance, and this final factor is labelled assurance.

Discussion

Denison acknowledges that the four cultural traits in his model are summary characteristics of an organization's culture and within those traits are variables providing a comparative response by respondents on the processes by which culture may have an impact on effectiveness. By focusing on the comparative analysis of effectiveness and assurance, the Denison model may be modified to include new factors to broaden the culture model.

The concept of effectiveness is complicated due to its multidimensional nature which requires effectiveness to normally be defined by a complex set of programme stakeholders, who may seek differing, incompatible, and changing benefits from the programme (Denison and Mishra, 1995)

The measurement model in this study looks at the effectiveness of the programmes as one outcome measured by their performance in achieving the continuing airworthiness along with the decision-making processes used in managing the delivery outcome. The behaviours and assumptions of the members of these programmes to ensure the achievement of this outcome, along with the associated decision-making processes is the cultural trait of assurance.

Programme management organization culture model

The five factors derived from the CFA in Figure 1 can be arranged in a competing values framework where quadrants are used to diagonally describe potentially competing organizational behaviours and hemispheres identify opposite characteristics of the organization; stable/flexible and internal focus/external focus (Cameron and Quinn, 2006).

The CFA result includes the fifth dimension for assurance which acts as the glue holding the competing organizational culture forces together. The basic elements of the programme management organizational culture model, also referred to as 'the proposed model', are presented graphically in Figure 2.

The dynamics of the model specify the bidirectional influence of certain pairs of organizational culture factors on the overall cultural environment which members of a programme will work, along with the role of assurance as a key part of programme governance in creating the environment for success. The multiple interactions between the model's 40 organizational culture variables and the dynamic processes of the five organizational culture factors affecting the programme objectives are detailed in the model, with attention to how programme members solve problems and make decisions.

The remaining sections of this paper describe the components of the model, delineating the interaction of organizational culture and programme performance, and illustrating the comparative differences between the organizational cultures of the seven programmes evaluated.

Strategic alignment

The executive leadership of an organization shapes the perception of the daily routines which help define the organization culture (Hofstede and Hofstede, 2005). Incorporating the flow downs from the organizational culture, project leadership must shape the shared perceptions of project work practices to provide alignment with the organization's goals and objectives, and in doing so create the project culture (Müller and Turner, 2007). Research has confirmed that by taking an holistic perspective on culture that includes strategic fit and adaptability, a more complete description of the relationship between the organizational culture and performance can be developed (Kotter and Heskett, 1992; Denison and Neale, 1996).
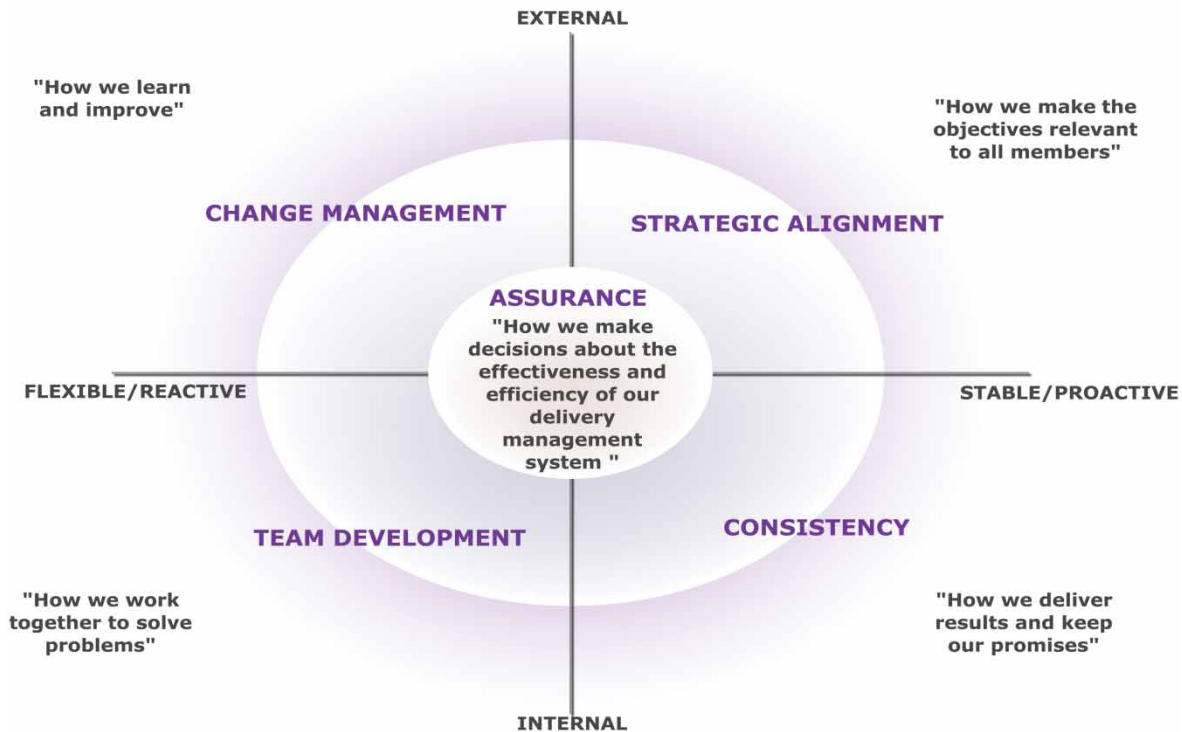
Specifically the assumptions and behaviours in place within the programme ensure that the programme objectives are relevant to all members. This factor includes variables associated with:

- Clear and well communicated strategies exist for achieving the programme goals.
- Ambitious but realistic objectives support these strategies.
- Each team member knows how they will help the programme achieve its goals.

Team development

Reason (1998), studying the commercial aviation industry identified the main organizational traits that

Program Management Organisational Culture Model

Figure 2 Programme management organizational culture model

affect a safety culture; trust is high and working together is acknowledged as the way to solve problems. Specifically, the assumptions and behaviours in place within the programme that ensure programme team members work together to solve problems. Within the project context, Cheung *et al.* (2011) highlighted that the two most highly ranked organizational culture factors for projects were; goal setting and accomplishment, and team orientation. This factor in the final model includes variables associated with:

- People work as though part of a team.
- Good collaboration is encouraged by programme leadership who understand the work done by the teams.
- The capabilities of teams are important in achieving the goals. This belief is reflected in the training and skills of individuals.

Change management

Successful programmes deliver change for their organization in a controlled manner. Change is a source of both new scope and either risk or opportunity. Specifically, the assumptions and behaviours related to increasing

or decreasing risk (Guldenmund, 2000), and the ability to learn from events in order to improve the programme effectiveness. This factor includes variables associated with:

- Adapting and taking a proactive approach to risk management and change. Staff shares safety information, and the results from its analysis.
- Anticipating issues and risks creates the ability to draw the right conclusions from the safety information which is linked to better performance and the avoidance of the unwanted consequences of risks.
- Innovation is encouraged and rewarded.

Consistency

The project work practices are characterized by the way in which project planning, execution, and control stages of the project are exercised (Shore and Cross, 2005). Researchers in the project and programme management domain have also proven relationships between the task orientation of the culture with performance (Andersen, 2003; Cheung *et al.*, 2011). Specifically, the part of the culture which shapes the assumptions and behaviours within the programme that ensures consistent delivery

of results and keeping of promises. This factor includes variables associated with:

- Leadership are consistent with what they say and what they do.
- The programme has a clear and consistent set of values.
- Programme has a homogenous culture.
- Clear agreement exists about the right way and wrong way to do things in the programme. Processes guide decision-making and the approach towards business which is very consistent and can easily be anticipated.
- People from different parts of the programme share a common perspective.

Assurance

Where an organization employs a programme of concurrent and interrelated projects to achieve a common business objective, then the programme leadership has a role in establishing the organizational culture, practices and behaviours, which optimizes the benefits sought from the programme. Programme governance is about ensuring 'decision-making and delivery management activities are focused on achieving program goals in a consistent manner, addressing appropriate risks, and fulfilling stakeholder requirements' (PMI, 2008). Assurance is a key part of governance and represents the behaviours and assumptions that ensure programme decisions are made about the effectiveness and efficiency of the delivery management systems in the programme using the right information. The features of this factor include variables associated with:

- Goal systems define the programme objectives.
- Agreement exists that programme goals are correct.
- Performance and progress is measured against goals.
- Systems gather, process, share and store information.
- Clear accountability exists for making decisions.
- Decision-making is focused on goals.
- Decisions are balanced to meet short-term demands without compromising long-term goals. Noting that the use of judgement and standards are the key decision practices adopted in stable situations, and analytical processes aimed at avoiding unwanted risk consequences are adopted in situations involving change (Strutt *et al.*, 2006).

Validation and limitations of research

The final measurement model outlined in this paper provides a better explanation than the hypothesized model for the organizational culture of a programme and the inter-relationship with a single safety outcome; ensuring continuing airworthiness. The measurement model explained 74.9% of the variance in the observed data, whereas the hypothesized model only explained 64.9%. All the factors in the final measurement model returned high levels reliability with internal consistency figures for Cronbach's alpha greater than 0.8 (refer to Table 3). However, the goodness-of-fit indices were low; CFI = 0.87 where acceptance is at levels greater than 0.95 (Schreiber *et al.*, 2006).

It would be premature to apply this model broadly as there are several limitations in the study. Firstly, the data for the study was collected from major Australian domestic airlines and the findings may be different if the same study was conducted in a different part of the aviation industry experiencing significantly different industry environmental forces. Secondly, although the study returned 211 responses, this sample size is considered small for the variables used in the study, and a sample size of 400 would have been more acceptable.

In addressing these limitations, an extension to this study should be carried out using the organizational culture measurement model developed; both expanding the sample size and including a different sector of the aviation industry.

Implications for programme governance

There have been significant programme failures in aviation that have been linked to decision-making practices of teams (Shore, 2008; ATSB, 2011), and so understanding how the organizational culture relates to the decision-making practices employed by the programme is essential information for programme governance.

Using the programme management organizational culture model outlined in this paper, the organizational cultures of the seven programmes were compared. The chart (Figure 3) shows the different profiles for the seven programmes (A–G); where the cultural trait index is the programme's average rating for that group of observed variables (refer to Table 2 for list of variables for each factor). The information available from this programme organizational culture model allows the management to understand the strengths and weaknesses of decision-making within their programmes.

While each programme has its own strengths and weaknesses across the competing values of team development, consistency, change management and strategic alignment all programmes rated relatively strong or homogeneous cultural indices in assurance. The way that assurance is measured in this model indicates high levels of agreement from team members that programme behaviours and practices support the effectiveness of judgement decisions made in their teams.
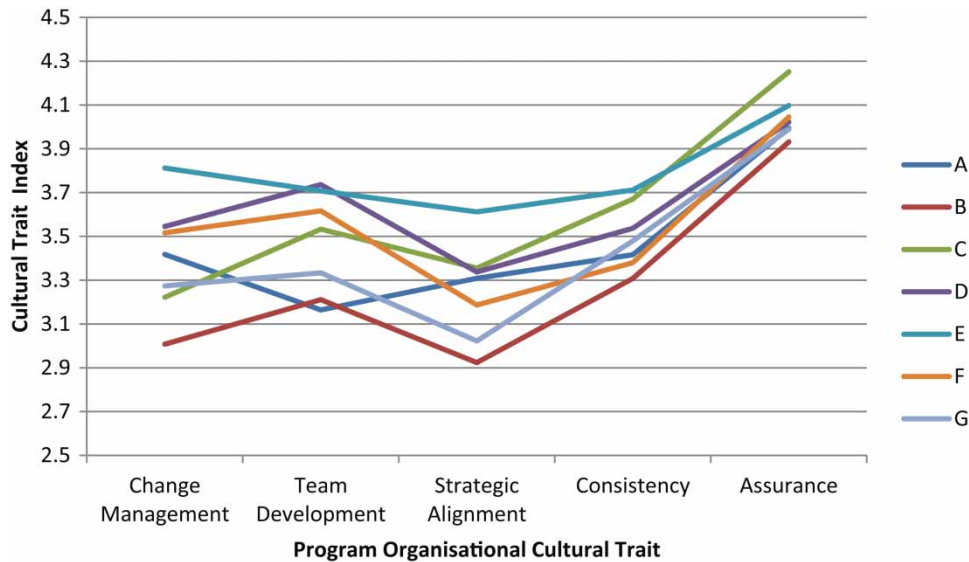
Figure 3   Cultural traits and indices for seven programmes

The other four factors; team development, consistency, change management and strategic alignment all had relatively weaker or less homogeneous results across all seven programmes. Weaker cultural indices in change management may indicate less mature uncertainty avoidance processes which should be aimed at avoiding future negative consequences of events within the programme. Additionally, weaker cultural indices in consistency indicate there is no clear agreement about the way things are done within the programme; this may result from immature standards or underdeveloped processes within the programme.

While team members in these programmes report high levels of agreement that programme practices and behaviours support their judgement decisions, the relatively lower scores in team development and strategic alignment indicate potential issues for some programmes. The weaker results in team development may indicate that some information is not being shared across team boundaries. Furthermore, while team members may believe their judgements are focused on the programme objectives, the strategic alignment index indicates that communication about the alignment of these objectives with some programme goals and strategies is relatively weak.

Finally, the overall results show that the seven programmes are mainly focused on the stable 'business as usual' environment, relying heavily on individual judgement decisions of team members. This imbalance in programme organizational culture may also indicate an imbalance in the decision-making practices required to deliver balanced outputs that meet both short-term demands without compromising the longer term goals.

While each programme reports that behaviours and practices support members judgement decisions related to the achievement of the programme continuing airworthiness outcome, the less homogeneous results for the other cultural traits indicate that each programme may have varying levels of success in realizing the safety outcome benefit, continuing airworthiness of their aircraft. Further studies could investigate the relationship of these cultural indices with performance of the programme.

Conclusions

There is a number of competing value frameworks for measuring organizational culture, and these models offer a summary of core cultural characteristics that may be used for comparing general culture factors between organizations, but do not provide the best model for performing a detailed analysis of the interrelationship between cultural traits and a specific performance outcome as studied in this paper. Unique external environmental forces, such as regulations and industry standards, impacting on programmes mean that some cultural dimensions or traits in these models do not help in describing the programme organizational culture. By modifying an existing model to add an additional cultural trait of assurance, while focusing the observed variables onto the outcome measure of continuing airworthiness enabled the development of a more suitable measurement model.

The development of the proposed model for organizational culture in airworthiness management programmes started with the Denison model as the basis

for measuring the input variables, but the final model did not incorporate the Denison cultural traits of vision, empowerment and customer focus. Only 57% of the input variables used to collect the data for this research remained in the final model that best describes the organizational culture for the seven airworthiness management programmes; explaining 74.9% of variance. Removing these redundant cultural traits from the final model allowed a more focused analysis of the organizational culture of the seven programmes.

Different industries have unique external forces acting on their programmes. When studying the organizational cultures in programmes and their impact on effectiveness, industry-specific models similar to that proposed in this paper should be considered.

The organizational culture of a programme reflects the practices and behaviours used when making decisions that impact on the effectiveness and efficiency of delivery management systems. The proposed measurement model reported in this paper provides the best fit for measuring the organizational culture of the airworthiness management programmes investigated. The proposed model could be used by airlines when seeking to improve the decision-making and overall performance of their airworthiness management programmes.

This proposed model will be used for further research investigating which cultural traits act as predictors to performance in achieving the programme goals. This further research should also aim to address the research limitations presented in this paper.

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