The determinants of a culture of quality for Bolivian firms

Boris Christian Herbas Torrico and Jarin Canaza Fernandez
Exact Sciences and Engineering Research Center (CICEI)
Bolivian Catholic University
Cochabamba, Bolivia
bherbas@ucb.edu.bo, jarincanaza@gmail.com

Abstract

Philip Crosby famously said that *"Quality is the result of a carefully constructed cultural environment. It has to be the fabric of the organization, not part of the fabric."* This quote suggests that quality must find new approaches for their study that go beyond traditional conceptualizations, such as the study of the *culture of quality*. Worldwide, there are a series of studies about the culture of quality. However, in Bolivia and South America, no studies have analyzed their determinants. Thus, our research surveyed 185 Bolivian managers and through the use of statistical modeling, we found that customer focus, quality vision, and quality values positively influence the culture of quality. Additionally, we developed a culture of quality index to rank the surveyed firms according to their score. We found that: (a) large firms; (b) firms that implemented quality standards; and (c) product manufacturing firms have the highest culture of quality scores. In contrast, (i) SME's; (ii) firms that did not implement quality standards; and (iii) service firms showed the lowest culture of quality scores. Finally, we discuss the implications and strategies for Bolivian firms.

Keywords
Quality, Culture of quality, Customer focus, Quality vision, Quality values, Culture of quality index.

1. Introduction

Culture of quality is a concept that emphasizes the importance of informal and non-structural aspects of quality (Sattler and Sonntag 2016). According to Mahli (2013), a culture of quality is a system of shared values, beliefs, and standards, which are focused on delighting customers and continually improve the quality of products and services. Also, Campos et al. (2014) suggest that the development of a culture of quality is a strategic issue in highly demanding and uncertain business environments to (a) achieve customer satisfaction; and (b) firm competitiveness. Therefore, Zgodavova et al. (2017) suggest that to achieve a firm's excellence a culture of quality is a must.

Within the South American, and particularly Bolivian literature, there are no specific studies on the culture of quality. Therefore, our research is the first of its kind in South America and Bolivia to study the determinants of a culture of quality. For the analysis, we sampled 185 Bolivian firms using the dimensions suggested by Forbes Insights (2014). Specifically, the study of Forbes Insights suggests the existence of five dimensions that determine a culture of quality in firms: (a) customer focus; (b) organizational vision (c) values related to quality; (d) leadership; and (e) incentives. Next, through the use of General Linear Models, we develop a statistical model for the determinants of a culture of quality. Next, we calculate a Culture of Quality Index to classify our sampled firms. Finally, we present our conclusions and recommendations.

2. Literature review and hypotheses

Next, we present literature relevant to our research. Afterward, we present our hypotheses and conceptual model based on the literature review.

2.1. Determinants of a culture of quality

According to Batten (1994), a culture of quality is the set of a firm's habits and values related to quality. These are complemented with the daily quality practices, allowing the firm to reach its strategic objectives. Available literature suggests that the dimensions that determine a culture of quality are (see Figure 1): (a) employee participation and empowerment (Forbes Insights 2014; Abenbajo and Kejor 1998; Srinivasan and Kurley 2014; Cameron and Sine 1999); (b) quality spirit (Abraham et al. 1997; Campos et al. 2014; Zgodavova et al. 2017); (c) leadership (Forbes Insights 2014; Abenbajo and Kejor 1998; Campos et al. 2014; Zgodavova et al. 2017); and (d) incentives (Forbes Insights 2014; Johnson 2000; Davison and Al-Shaghana 2007).

In particular:

a. **Employee involvement and empowerment:** it is related to *customer focus.* Specifically, is a way in which the firm sees their customers as its priority. Customer focus establishes to what extent a firm's product or service achieves widespread acceptance and customer satisfaction (Berlinches 1998). Also, is fundamental for the firm's success in economies that are becoming more competitive and globalized (Boyce 2000).
b. **Quality spirit:** it has two dimensions, *quality vision,* and *quality values*. Particularly, quality vision is a strategy supported by top management and determines how the search for quality attains the objectives in a firm (Forbes Insights 2014). On the other hand, quality values are conceptions of what is desirable. Moreover, these guide how stakeholders (leaders, policymakers, people in general) decide actions, evaluate people, and explain their actions and evaluations (Kluckhohn 1951). Also, they are fundamental to firms' growth. Furthermore, they define culture and greatly improve the scope of their objectives (Forbes Insights 2014).
c. **Quality-oriented leadership:** it is related to the *firm's leadership.* The leadership role of creating a culture of quality is related to provide the vision and the direction for the firm's improvement strategies (Forbes Insights 2014; Tomic 2017). Early research defined leadership as one of the attributes of great leaders (Bernard 1926). However, conceptually the focus has shifted. Current research is focused

on analyzing leaders' behaviors, and looking to determine the causes of their success (Halpin and Winer 1957; Hemphill and Coons 1957).

d. **Motivation:** is related to *incentives to guarantee or reward quality*. Incentives are ways in which employees of a firm should be rewarded or motivated for their achievements and performance (Dean 1994; Tomic 2017; Forbes Insights 2014). Stajkovic and Luthans (2001) classified the incentives in (i) financial incentives (remuneration, bonuses, and prizes); and (ii) non-financial incentives (awards, spare time).

3. Conceptual model and research hypotheses

Based on the dimensions identified in the available literature, we developed our theoretical model (Figure 1). Specifically, next, we will present each of the hypotheses developed in Figure 1.

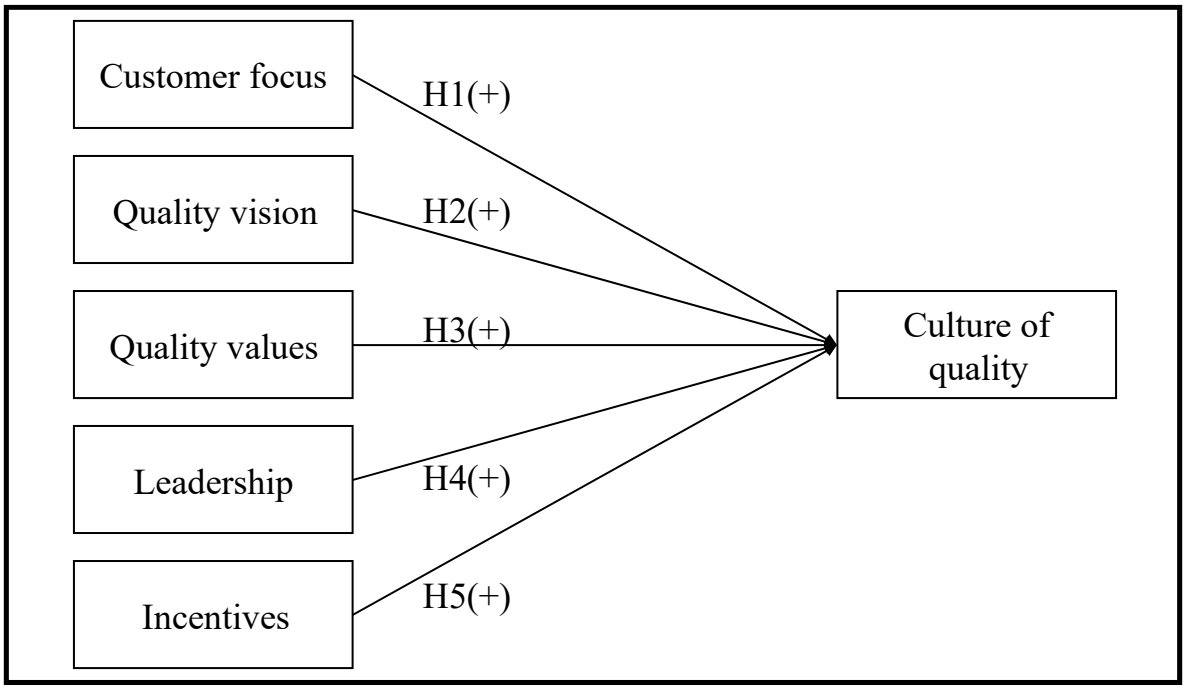

Figure 1. Conceptual model

First, the model suggests that customer focus is a means by which the firm prioritizes quality by creating patterns of beliefs, behaviors, and practices oriented towards customer satisfaction. In this sense, available literature suggests that customer focus positively and significantly influences a culture of quality (Forbes Insights 2014; Cameron 1999; Adebanjo and Kehoe 1998). Therefore, a firm's customer focus promotes the formation of a culture of quality.

H1. Customer focus positively influences a culture of quality.

Additionally, business strategies that seek to meet quality objectives are based on the firm's quality vision. Available research suggests that quality vision is an element that any firm looking to develop a culture of quality should have. Moreover, this dimension positively influences a culture of quality (Kottman and Huisman 2016; Patel and Baker 2015; Forbes Insights 2014). Specifically, a culture of quality starts with the firm's vision. This vision guides values and provides it with purpose. That purpose, in turn, guides every quality decision the operators make. Therefore, the literature suggests that the firm's quality vision guides the firm towards the development of a culture of quality.

H2. Quality vision positively influences a culture of quality.

On the other hand, several authors indicate that quality-related organizational values help workers from all hierarchical levels to make better and more responsible quality decisions. Moreover, these values are given by management and are implemented in all the firm (Campos 2014; Cameron 2009; Tomic 2017). Specifically, values influence operators' behavior because they use them to decide between decisions. Quality values are cornerstones of who operators are and how they do things. They form the basis of how operators see themselves as individuals, how they see others, and how they interpret the world in general. Therefore, quality values act as a moral compass that determines patterns of a firm's behavior and thus influence the formation of a culture of quality.

H3. Quality values positively influences a culture of quality.

Additionally, the literature suggests that leadership is an influential dimension on a culture of quality. Particularly, a firm's leadership should convey real and credible messages to convince employees to improve the culture of quality (Dimitriades 2001; Guillen and Gonzales, 2001; Campos 2014; Forbes Insights 2014). Specifically, leadership has a strong impact on a firm's culture of quality because: (a) determines plans; (b) prioritizes work; (c) manages; (d) leads; and (e) delegates. Strong leadership provides a sense of vision, purpose, mentorship, and inspiration to operators. Therefore, leadership gives credibility and messages to allow the formation of a culture of quality.

H4. Leadership positively influences a culture of quality.

Finally, the literature indicates that workers must be kept motivated to develop a culture of quality (Dean 1994; Tomic 2017). In that sense, Kottman (2016), Tomic (2017), and Forbes Insights (2014) found that an effective reward system of incentives is related to the development of a culture of quality. Specifically, incentives create positive feelings on operators motivating them to follow the firm's quality initiatives. Therefore, a firm's reward system motivates workers to develop and maintain a culture of quality.

H5. Incentives positively influences a culture of quality.

4. Methodology

To determine the validity of the proposed hypotheses, we used Generalized Linear Models (GLM). We selected this statistical method because we considered that the assumption of normality was not necessary to measure the relationships under analysis (Nelder and Wedderburn 1972) and due to possible asymmetries on the surveyed responses. Moreover, based on Forbes Insights (2014) and Campos (2014), we developed a survey for firm managers using 10-point Likert scales.

5. Data analysis and results

5.1 Sample description

A representative sample was collected in Bolivia from October 2017 to January 2018. In particular, 185 firm managers from different Bolivian industries were surveyed. Our sample had the following characteristics: (a) 87% are small and medium-sized firms (SME's); (b) 49% belonged to the manufacturing industry and 51% to the service industry; (c) 90% were private firms and 10% were public firms; (d) 75% have not implemented the ISO 9001:2015 standard and 25% did; (e) 60% of the respondents were senior executives, 40% were quality professionals (quality managers, and supervisors); (f) 60% of the respondents were men and 40% were women; and (g) the average age of the respondents was 42 years old. Therefore, as Fig. 2 shows, our sample is mostly made up of private firms, SME's, and firms that have not implemented ISO 9001:2015.

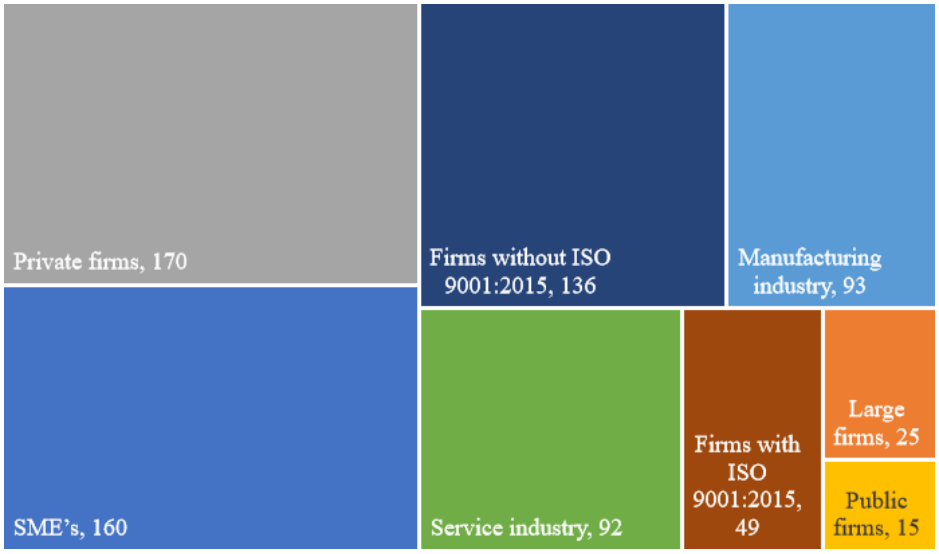

Figure 2. Treemap of the collected sample

5.2 Model results

Initially, due to their non-parametric advantages (Bonnet and Wright 2000), to measure the degree of association between the dependent and independent variables we used Spearman's rank correlations. As Table 1 shows, all independent variables showed statistically significant associations with the culture of quality dimension ($p <$ 0.05).

Table 1. Spearman's rank correlation coefficients between culture of quality and quality dimensions

Dimension	**Spearman's** ρ
Customer focus	0,248**
Quality vision	0,317**
Quality values	0,320**
Leadership	0,296**
Incentives	0,126*

Note. *p <0.05; **p < 0.01

Next, we used GLM to see whether the statistically significant relationships identified with Spearman's rank correlations hold in our hypothesized model. Specifically, we used the Newton-Raphson approach for the calculation of our hypothesized model, since it performs several iterations to an optimum equilibrium point at which model parameters are consistent (Fienberg and Rinaldo 2012). This approach was chosen because it allows us to see which variables are important in the model while keeping knowledge from the independent variables. As a result, we calculated the standardized coefficients (β) to determine the probability of the firm belonging to a high, medium, or low culture of quality (Cameron 1999). As Table 1 shows, our results suggest that customer focus, quality vision, and quality values statistically influence a culture of quality ($p < 0.05$). However, we also found that leadership and incentives did not significantly influence a culture of quality.

Table 2. GLM model results

Dimension	β	Pr(>|z|)
Customer focus	0,627	0,013*
Quality vision	0,544	0,001**
Quality values	1,054	0,022*
Leadership	0,450	0,141
Incentives	0,138	0,121

Note. *p <0.05; **p < 0.01

5.3 Hypothesized relationships

The results shown in Table 1 suggest that H1, H2, H3 are supported. However, H4 and H5 were not supported. Specifically, our results suggest that for Bolivian managers, a culture of quality is determined by customer focus, quality dimension, and quality values. However, leadership and incentives do not determine a culture of quality. In particular, these results suggest that Bolivian managers consider that a culture of quality depends on prioritizing customer satisfaction, quality purpose, and the existence of a quality moral compass. Conversely, they do not consider that strong leadership messages and incentives motivate the firm to develop a culture of quality.

Due to the parsimony principle, we eliminated two variables of the model (leadership and incentives). As a consequence, the variance explained (D^2) increased 2% to 26.08%. Moreover, the independent variables included in the model were positive and statistically significant (see Figure 3). This result suggests that, although our model has a relatively low variance explained, the relationships under analysis remained statistically significant.

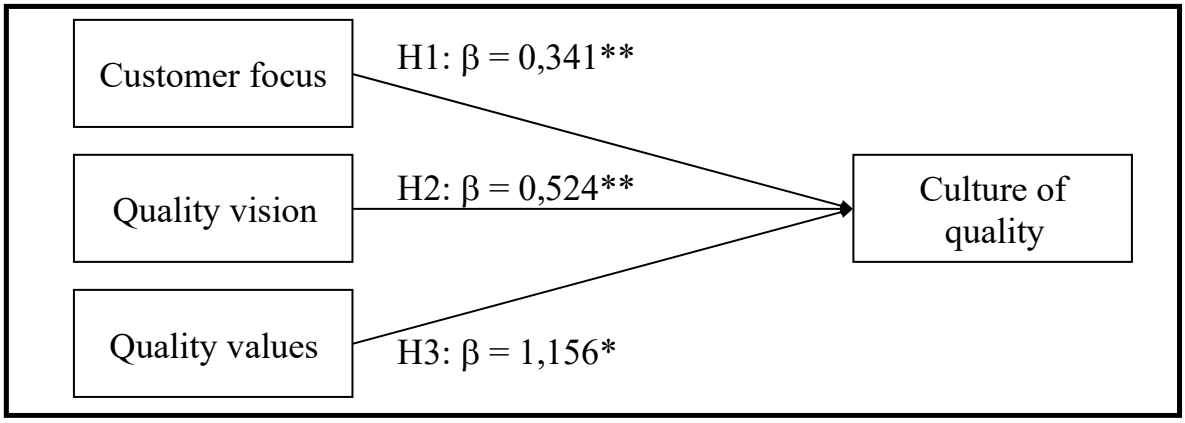

Figure 3. Fitted model

Note. β: Standardized coefficient; *p <0.05; **p < 0.01

5.3.1 Model stability tests

The adjusted model underwent stability analyses introducing control variables. Specifically, we wanted to determine if the introduction of control variables into the model increased the degree of variation between variables to values higher than 10% (Abraira and Perez 1996; Aguayo 2007). The control variables introduced

into the model were: (a) firm size; (b) firm type; (c) industry; (d) business role; (e) ISO 9001:2015 implementation; (f) respondent's gender (g) respondent's age (see Table 3).

Table 3. Variation percentage between variables

Control variables	Customer focus	Quality vision	Quality values
Firm size	3,31	1,98	2,54
Firm type	0,99	0,05	0,01
Industry	0,66	3,95	3,11
Business role	2,65	0,85	0,85
ISO 9001:2015	6,85	0,75	1,79
Respondent's gender	1,8	4,91	5,42
Respondent's age	2,8	1,16	1,98

The values presented in Table 3 show that no control variable causes significant instability in the model (variation percentage ≤ 6,85%). Moreover, Aguayo (2007) suggests that a model can be considered stable when the inclusion of control variables does not change the percentage of variation higher than 10%. Therefore, our model is statistically stable (see Table 3).

6. Culture of quality index

Additionally, based on the variables of the adjusted model (see Figure 3), to classify the surveyed firms we calculated a culture of quality index. This index calculated the ranked position of each firm concerning its culture of quality. Moreover, this index classified each firm using a scale from 1 to 100 points. The results shown in Table 4 show the first 10 firms (out of 185 firms) for our calculated culture of quality index. In particular, the table reveals that large firms are the first 10 firms of the ranking, and are the most likely to have a high culture of quality. Furthermore, five firms belong to the manufacturing industry and five firms are from the service industry. Finally, eight out of 10 firms have implemented ISO 9001:2015 standard. These results revealed that a high culture of quality is common in firms that are: large, have implemented the ISO 9001:2015 standard, and belong to the manufacturing or service industry.

Table 4. Culture of quality ranking

Ranking	Firm	Probability of high culture of quality	Index value
1	Banco Bisa S.A.	0,965	96,50
2	Banco Nacional de Bolivia S.A.	0,964	96,42
3	Embol S.A.	0,962	96,22
4	Imcruz Comercial S.A.	0,958	95,89
5	Pil Andina S.A.	0,959	95,88
6	Tigo Telecel S.A.	0,957	95,75
7	Unilever Andina Bolivia S.A.	0,951	95,13
8	YPFB Refinación S.A.	0,951	95,08
9	Grupo Venado S.A.	0,949	94,88
10	Banco Mercantil Santa Cruz S.A.	0,946	94,57

Next, to further analyze our results, we grouped firms according to their size, implementation of ISO 9001:2015, firm type, and industry. As Table 5 shows, higher culture of quality indices is common to (i) large

firms; (ii) firms that implemented the ISO 9001:2015 standard; (iv) and belong to the manufacturing industry. Conversely, the firms that showed the lowest culture of quality scores are (a) firms from the service industry (b) firms that did not implement the ISO 9001:2015 standard; and (c) SME's.

Table 5. Culture of quality indices for Bolivian firms

Culture of quality index	Score
Large firms	70,39
ISO 9001:2015	67,29
Manufacturing industry	65,44
Public	61,06
Private	59,44
SME's	57,44
No ISO 9001:2015	56,04
Service industry	39,95

These results from Table 5 suggest that higher quality of culture indices are due to (a) increased capital, specialized human resources, and machinery in large firms (Kottman 2016; Forbes Insights 2014); (b) the useof quality standards that show firm's motivation to improve their quality (Hildebrant 1991); and (c) higher standardization and use of quality standards in the manufacturing industry, and thus higher customer satisfaction(Fornell et al. 1996; Gao 2012). On the other hand, the lower culture of quality indices are due to lower firm size, higher process variability, and the absence of a clear quality framework for improvement (de las Casas 2016; Fornell et al. 1996; Pino 2006).

7. Conclusions and discussion

Our study analyzed the determinants of a culture of quality in Bolivian firms. We surveyed 185 firm managersfrom different Bolivian industries. Statistical modeling showed that a culture of quality is positively and significantly influenced by customer focus, quality vision, and quality values. However, our results show that leadership and incentives do not influence a culture of quality. These results suggest that for surveyed managersa culture of quality does depend on customer focus, quality dimension, and quality values. Nonetheless, leadership and incentives do not determine a culture of quality. In other words, Bolivian managers consider thata culture of quality depends on prioritizing customer satisfaction, quality purpose, and the existence of a qualitymoral compass. However, surveyed managers do not consider that strong leadership messages and incentives motivates a firm to develop a culture of quality. In contrast to the surveyed managers, Srinivasan and Kurey (2014) suggest that managers should see quality as a top priority, "walk the talk" on quality, and emphasize theimportance of quality. On the other hand, similar to the results of Srinivasan and Kurey (2014) our results alsoshow that incentives do not determine a culture of quality. In other words, operators must be passionate about eliminating mistakes. Therefore, the literature suggests that Bolivian managers should emphasize strong leadership without showing gaps between what they say and what they do about quality. Furthermore, we developed a culture of quality index which showed that higher culture of quality indices are common among large firms, firms that implemented quality standards, and from the manufacturing industry. Conversely, the lower culture of quality indices are common among SMEs, firms that did not implement quality standards, andfrom the service industry. These results suggest that these firms should improve their customer focus, developa compelling quality vision, develop the firm's quality philosophy, standardize their processes, and increase customer satisfaction.

Every research has limitations, and our research is no different. One of the limitations of our research is related to the model itself. Specifically, our model has a low variance explained. Future studies can use structural equation modeling or other methodologies to confirm the relationships we found. Moreover, other researchers can use different scales for leadership and incentives to test whether their relationship with the culture of quality is statistically non-significant. Additionally, researchers from other South American countries can use our framework to test the culture of quality of the firms operating within their borders.

Finally, our research shows that Bolivian and South American firms can evaluate their culture of quality to improve their global competitiveness. Firms should always remember that as Philip Crosby once said *"Quality is the result of a carefully constructed cultural environment. It has to be the fabric of the organization, not part of the fabric."*

References

Abraira, V. and Pérez, A., *Métodos multivariantes en bioestadística*, Editorial centro de estudios Ramón Areces S.A, Madrid, 1996

Abraham, M., Fisher, T., & Crawford, J., Quality culture and the management of organization change, *International Journal of Quality & Reliability Management*, 1997.

Adebanjo, D. and Kehoe, D., An evaluation of quality culture problems in UK companies, International Journal of Quality Science, vol. 3 no. 3, pp. 86-275, 1998.

Aguayo, M., Confusión e interacción (1): Qué son, qué suponen y cómo manejarlas en el análisis estratificado, *Fundación Andaluza Beturia para la investigación en Salud*, Sevilla, pp. 1-8, 2007.

Batten, Joe., A total quality culture, *Management Review*. Academic One File, vol. 83 no. 5, pp. 61, 1994.

Boyce, G.,Valuing customers and loyalty: the rhetoric of customer focus versus the reality of alienation and exclusion of (de valued) customers, *Critical perspectives on accounting*, vol. 11, no. 6, pp. 649-689, 2000.

Cameron, K. & Sine, W., A framework for organisational quality culture, *Quality Management Journal*, vol. 6, no. 4, 1999.

Campos, A., Mendes, J., Silva, J. A. and Valle, P., Critical success factors for a total quality culture: a structural model, *Tourism & Management Studies*, pp. 7-15, 2014

Casas, J. B., and Pérez-Cepeda, M., El ISO 9001 y TQM en las empresas de Ecuador, *Journal of Globalization, Competitiveness & Governability*, vol. 10, no. 3, pp. 153-176, 2016.

Davison, L., & Al-Shaghana, K., The link between Six Sigma and quality culture–an empirical study, *Total Quality Management & Business Excellence*, vol. 18, no. 3, pp. 249-265, 2007.

Dean, J.W. and Evans, J.R., Total quality management, organization and strategy, *West Publishing Company*, Minneapolis, MN, pp. 209, 1994.

Dimitriades, Z. S., Empowerment in total quality: designing and implementing effective employee decision-making strategies*, Quality Management Journal*, vol. 8, no. 2, pp. 19-28, 2001.

Fienberg, S. E., & Rinaldo, A. Maximum likelihood estimation in log-linear models, *Annals of Statistics*, vol. 40, no. 2, pp. 996–1023, 2012.

Fichman, M., Variance explained: why size doesn't (always) matter. *Research in Organizational Behavior*, pp. 295–331, 1999.

Forbes Insight, Culture of Quality – Accelerating growth and performance in the enterprise, *Forbes Insight in association with ASQ*, New York, 2014.

Fornell, C., Johnson, M., Anderson, E., Cha, J., and Bryant, B., The American customer satisfaction index: Nature, purpose, and findings, Journal of Marketing, vol. 60, no. 4, pp. 7–18, 1996.

Gao, Z., Ye, J., Huang Yi., Study on the construction of enterprise quality culture for brand strategy, *School of Management*, Northwestern Polytechnical University, Xi'an, China, vol.4, pp. 260-264, 2012.

Guillén, M. and González, T., The ethical dimension of managerial leadership: two illustrative case studies in TQM. *Journal of Business Ethics*, vol. 34, pp. 175-189, 2001.

Halpin, A. W., and Winer, B. J., A factorial study of the leader behavior descriptions, In R.M. Stogdill & A.E. Coons (eds.): Leader Beharivor: *The description and measurement*. Columbus, Ohio State University Res, pp. 39-51, 1957.

Hemphill, J. K., and Coons, A. E., Leader behavior: Its description and measurement, *Administrative Science Quarterly*, pp. 6-38, 1957.

Hildebrandt, S, Kristensen, K, Kanji, G and Dahigaard, JJ., Quality culture and TQM, *Total Quality Management*, vol. 20, no. 1, pp 1-15, 1991.

Irani, Z., Beskese, A., and Love, P., Total quality management and corporate culture: constructs of organizational excellence, *Technovation*, vol. 24, no. 8, pp. 643-650, 2004

Johnson, J. J., Differences in supervisor and non-supervisor perceptions of quality culture and organizational climate, *Public Personnel Management*, vol. 29, no. 1, pp. 119-128, 2000.

Kluckhohn, C., Values and value - orientations in the theory of action: an exploration in definition and classification, In T. Parsons and E. A. Shils (Eds), Toward a General Theory of Action. Cambridge, Mass.: Harvard University Press, pp. 388-433, 1951.

Kottmann, A., Huisman, J., Brockerhoff, L., Cremonini, L., and Mampaey, J., How can one create a culture for quality enhancement?, Final report. Enschede, Ghent, 2016.

Laszlo, G. P., Implementing a quality management program–three Cs of success: commitment, culture, cost, *The TQM magazine*, 1999.

Malhi, R. S., Creating and sustaining: a quality culture, *Journal of Defence Management*, vol. 3, no. 2, 2013.

Nelder, J. A., & Wedderburn, R. W. Generalized linear models, *Journal of the Royal Statistical Society: Series A (General)*, vol. *135, no.* 3, pp. 370-384, 1972.

Patel, P., Baker, D., Burdick, R., Chen, C., Hill, J., Holland, M. and Sawant, A., Quality culture survey report, *PDA J. Pharm. Sci. Technol*, vol. 69, no. 5, pp. 631– 642, 2015.

Pino, F. J., García, F., and Piattini, M., Revisión sistemática de mejora de procesos software en micro, pequeñas y medianas empresas, *REICIS. Revista Española de Innovación, Calidad e Ingeniería del Software*, vol. *2, no.* 1, pp. 6-23, 2006.

Sattler, C., Sonntag, K., and Götzen, K., The quality culture inventory (QCI): An instrument assessing quality-related aspects of work, In Advances in Ergonomic Design of Systems, Products and Processes, *Springer Vieweg*, Berlin, Heidelberg, pp. 43-56, 2016.

Srinivasan, A., Kurey, B., Creating a culture of quality. *Harvard Business Review*, vol. 92, no. 4, pp. 23-25, 2014.

Stajkovic, A. D., and Luthans, F., Differential effects of incentive motivators on work performance. *Academy of Management Journal*, vol. 44, no. 3, pp. 580-590, 2001.

Tomic, B., Spasojević Brkić, V., Karapetrovic, S., Pokrajac, S., Milanović, D. D., Babić, B., and Djurdjevic, T., Organizational culture, quality improvement tools and methodologies, and business performance of a supply chain, *Journal of Engineering Manufacture*, vol. *231, no.* 13, pp. 2430-2442, 2017.

Zgodavova, K., Hudec, O., and Palfy, P., Culture of quality: Insight into foreign organizations in Slovakia. *Total Quality Management & Business Excellence*, vol. 28, no. 9, pp. 1054-1075, 2017.

Biographies

Boris Christian Herbas-Torrico is a Professor of industrial engineering at the Bolivian Catholic University in Cochabamba, Bolivia. He earned his B.S. in Industrial Engineering from the University Mayor of San Simon in Bolivia. In 2007 he was awarded the Monbukagakusho Scholarship from the Japanese Ministry of Education, Culture, Sports, Science, and Technology to do his graduate studies in Japan. He received a master's and doctoral degree in industrial engineering and management from the Tokyo Institute of Technology (Japan). He has published journal and conference articles in the U.S. Japan, Europe, and South America. He received the 2012 Research Award from the Japanese Society for Quality Control. Additionally, in 2013 he was awarded the Nikkei Quality Control Literature Prize (Nikkei Keizai Shimbun). Moreover, in 2018 he was recognized by the Bolivian Senate for his contributions of science and technology to the country. In 2019 he was a visiting researcher at Waseda University (Japan). He has written two books and is an editorial board member for journals and conferences in Bolivia and abroad.

Jarin Canaza-Fernandez is a member of the AB-InBev Company and serves as a research assistant of industrial engineering at the Bolivian Catholic University in Cochabamba, Bolivia. He earned his B.S. in Industrial Engineering from the Bolivian Catholic Unversity in Bolivia. He had courses in data analysis at the Bolivian Private University. In 2019 he had a recognition at the first fair of scientific societies in Cochabamba, Bolivia. Also, he had collaborated with statistical analyses for higher education and of the COVID-19 research. His research interests include supply chain management, innovation and technology, higher education, and sales & marketing.