Work climate, innovativeness, and firm performance in the US forest sector: in search of a conceptual framework

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Abstract: Innovativeness can help companies differentiate themselves, with the ultimate goal of securing survival and improving performance. Modern theories in organizational behavior look at innovation as something that starts with individual creativity but that is also affected by the work environment. Using one broad industry sector, the US forest products industry, this study attempts to integrate into a unifying model the concepts of work climate, innovativeness, and firm performance using structural equation modeling. Results support the proposed theoretical model, with some modifications, finding a positive and significant relationship among all factors. Having innovation as a core part of a company's strategy and fostering a climate for innovation positively affects the degree of innovativeness and performance of a company. This is especially true for secondary or value-added wood products manufacturers. A climate for innovation is characterized by high levels of autonomy and encouragement, team cohesion, openness to change and risk taking, and sufficient resources available to people. Lack of a validation sample suggests treating the model as tentative until further testing.

Résumé : L'innovativité peut aider les entreprises à se démarquer les unes des autres avec comme objectif ultime d'assurer leur survie et d'améliorer leur performance. Les théories modernes du comportement organisationnel considèrent que l'innovation découle de la créativité des individus mais qu'elle est aussi influencée par le milieu de travail. Utilisant un large secteur industriel, l'industrie américaine des produits forestiers, cette étude tente d'intégrer dans un modèle unificateur les concepts de climat de travail, d'innovativité et de performance de l'entreprise en ayant recours à la modélisation par équation structurelle. Avec quelques modifications, les résultats supportent le modèle théorique proposé en mettant en évidence une relation positive et significative entre tous les facteurs. Le fait que l'innovation soit au cœur de la stratégie d'une entreprise et que celle-ci entretienne un climat propice à l'innovation affectent positivement son degré d'innovativité et sa performance. Ceci est particulièrement vrai pour les entreprises de seconde transformation du bois ou celles qui fabriquent des produits à valeur ajoutée. Un climat qui favorise l'innovation est caractérisé par un degré élevé d'autonomie et de support, la cohésion d'équipe, l'ouverture face aux changements et la disposition à prendre des risques ainsi que par la disponibilité de ressources suffisantes pour les personnes. L'absence d'échantillon de validation incite à considérer le modèle comme provisoire tant qu'il n'aura pas été davantage testé.

[Traduit par la Rédaction]

Introduction

There is an increasing realization of the wealth of knowledge and creativity inherent in employees. Fields like organizational behavior have devoted significant resources to understand how to bring out this potential via effective management (Burton et al. 2004). Recently, significant research has been devoted to assessing innovativeness of companies (Deshpande and Farley 2004; Hansen et al. 2007; Hult et al. 2004). However, these efforts have taken a rather restricted approach, where the antecedents and consequences of innovativeness have been less studied. Capon et al. (1996) call for more integrative studies of performance. Deshpande and Farley (2004) follow that approach and move away from bivariate studies (e.g., culture–performance). This study attempts to follow this call by providing an integrative theoretical framework. We look at innovativeness as a cultural phenomenon, readily observable in an organization's work climate (Denison 1996; Hurley and Hult 1998). We then try to identify those dimensions that describe a climate for innovation and link it to firm performance.

The review of past literature revealed several studies addressing constructs and relationships related to this study. However, we found several issues in that past research that justify our approach. For example, several studies have followed a regression approach (e.g., Deshpande and Farley 2004), as opposed to our use of a more robust technique, namely structural equation modeling. Several scales in past research had low reliabilities or failed to report this information. Furthermore, sample sizes were generally small. Also unique to this work are a more comprehensive definition of

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innovativeness and a more specific domain of organizational climate (climate for innovation).

Thus, the objective of this research is to extend the body of literature on innovativeness and organizational climate. We define and operationalize the constructs included in the model. The first of these focuses on the role of management in fostering innovation through what we term "innovation strategy". This is related but not equivalent to what Burton et al. (2004) refer to as "organizational strategy," where a firm's commitment to capital investment and innovation are dimensions of the construct. Secondly, we set boundaries to the broader organizational climate construct; hence, our domain of interest is an organizational climate that fosters innovation, and we refer to it as "climate for innovation". This construct includes the perceived stimulants to innovation in organizational work environments (see Operationalization). Thirdly, innovativeness is broadly defined as the openness to new ideas or a firm's orientation towards innovation (Hurley and Hult 1998). Firm performance refers to financial performance.

To address these research topics, a sample of firms from the wood products industry is investigated to test a theoretical model. The wood products industry is a major component of the US economy. Based on data from the 2002 economic census, this industry accounted for $258 billion in sales (five times as much as the steel and iron manufacturing industry), distributed among 33 000 manufacturers and 8000 wholesalers. These companies provided direct, permanent jobs to roughly 1×10^6 employees, totaling $27 billion in wages. The industry is known for having a large multiplier effect in terms of indirect jobs. One study found this multiplier to be equal to 2.2 in Oregon (Hovee 2004). As such, including the multiplier effect raises the contribution of the wood sector to $\geq 2 \times 10^6$ jobs across the United States. These figures support the importance for this industry to remain financially competitive and organizationally healthy.

The model addresses key antecedents and consequences of innovativeness and organizes them into a conceptual framework linking work climate, innovativeness, and performance. Drawing from past research, we adapted scales to assess these constructs. Drawing from literature, a model was developed and tested using structural equation modeling. The instrument we developed is readily available for any researcher or practitioner. More importantly, the climate dimensions we use in the model can be controlled directly by managers trying to foster a climate for innovation. Our proposed framework integrates past findings and opens up new venues of research.

Theory and hypotheses

Organizational climate and organizational culture

Organizational culture and organizational climate are concepts often used interchangeably. For this study, we follow Ekvall's (1996) approach and view climate as an organizational reality composed of "behaviors, attitudes and feelings, which are characteristic of life in the organization." Climate is seen as a perception of the dominant culture, and hence, it belongs to a lower level than culture. On the other hand, culture is understood as "the common set of values, beliefs and norms that help make sense of an organization" (Deshpande and Webster 1989). Culture is more normative and stable; climate is more descriptive and changeable. Thus, climate may be seen as the way culture is expressed at a point in time.

Relationships among climate, innovativeness, and performance

Using business to business companies, Deshpande and Farley (2004) studied the link between organizational culture, organizational climate, market orientation, innovativeness, and performance. Basing their assessment of culture on the competing values theoretical framework developed by Cameron and Quinn (1998), they compared different countries using a regression analysis approach and found no significant differences among them. Patterson et al. (2004) examined the link between organizational climate and performance, finding that job satisfaction acts as a positive mediator variable. In a thorough benchmark study of best new product development practices, Cooper et al. (2004) found that a supportive climate for innovation effectively discriminates between the best and worst performers. Drawing from dynamic capabilities theory, Lawson and Samson (2001) looked at innovation performance as a mediator between innovation capability and firm performance for high innovator firms.

Wei and Morgan (2004) looked at the peer to peer supportiveness of organizational climate using the work environment scale. They used market orientation as a mediator between climate and new product performance. They found a positive effect of a supportive climate on market orientation, which in turn was found to have a positive effect on new product performance. However, climate was found to have a nonsignificant effect on new product performance.

These studies suggest that climate is an organizational variable that exerts both direct and indirect effects on firm performance and lead us to propose the following.

H1: Having a climate for innovation is positively associated with firm performance. Two separate metaanalytical studies (Damanpour 1992; Vincent et al. 2003) found that several organizational factors had a positive relationship with innovation. Among the most relevant factors were managerial attitude toward change, availability of resources, market orientation, networking, and proper communications. Between these two studies, >30 years of research were summarized, and their findings suggest that climate exerts influences on processes that can result in innovation (Ekvall 1996). Innovativeness is the necessary organizational attitude of openness to new ideas that precedes innovation (the realization of innovativeness). The acceptance of innovation as an organizational value and goal is expected to promote an organization's openness toward the new. Consequently, we propose the following.

H2: Having a climate for innovation is positively associated with a firm's level of innovativeness. Calantone et al. (2002) looked at the effect of learning orientation on firm innovativeness and performance. They found a positive effect on both variables, with organization age acting as a moderator between learning orientation and firm innovativeness (stronger effect for older organizations). In a similar study, Hult et al. (2004) found that performance was positively affected by a learning orientation, market orientation, entrepreneurial orientation, and innovativeness. The effect of innovativeness on performance was found to be independent of market turbulence, measured as the rate of change of customers and their preferences. In a comprehensive meta-analytic review of innovation, Vincent et al. (2003) found innovation to be a positive mediator between organizational features (capabilities and structure) and firm performance. They found that organizational age detracts from innovation, whereas diversification, resources, and size are positively related to innovation. In addition, product innovation was found to promote financial performance. Crespell et al. (2006) studied one sector of the forest products industry and found a positive association between innovativeness and firm performance. Accordingly, we propose the following.

H3: A firm's innovativeness is positively associated with its performance. Burton et al. (2004) studied the relationship between organizational climate, organizational strategy, and financial performance. They operationalized climate in terms of tension, resistance to change, and conflict (Koys and DeCotiis (1991) and, by applying Zammuto and Krakower's (1991) model of competing values, proposed four climates: group, developmental, rational goal, and internal process. Strategy consisted of five categories following the Miles et al. (1978) typology (prospector, analyzer with innovation, analyzer without innovation, defender, and reactor). They found that some pairings of a firm's climate and its strategy are detrimental to financial performance. On a similar line, Lawson and Samson (2001) argued that strategy determines how firms prepare themselves to deal with uncertainty. They suggested that "successful innovation requires a clear articulation of a common vision and the firm expression of the strategic direction." We endorse this belief and adopt this idea under the concept of innovation strategy, which we define as the degree to which innovation is embedded in an organization's strategy (i.e., the firm's commitment to innovation). Accordingly, we suggest the following.

H4: Innovation strategy is positively associated with a firm's innovativeness. Murphy et al. (1996) called for the use of control variables when assessing performance. They found four variables to be relevant: firm size, industry, age of the firm, and risk. The forest products industry can be separated according to input materials into primary and secondary manufacturers. Primary manufacturers depend on raw materials as their principal input and are mostly commodity manufacturers. They include sectors such as sawmills and wood panels, among others. Secondary manufacturers are more specialized subsectors. Unlike primary manufacturers, they take primary wood products and physically alter them by changing the dimension, shape, chemical composition, or appearance. This sector covers a wide range of value-added products, such as millwork, doors and windows, furniture, cabinets, and others. Firms belonging to these two groups tend to differ in terms of firm size and age, with secondary manufacturers generally being smaller and younger and immersed in an environment characterized by many players and fierce competition. Secondary manufacturers are also closer to the final customer and are more labor intensive. This may translate into faster and higher rewards from the marketplace and a more efficient implementation of innovations (Jaworski and Kohli 1993). We argue that, even though secondary manufacturers may be at disadvantage in terms of the level of innovativeness they can achieve or afford, given a similar level of innovativeness, secondary manufacturers may be more effective in realizing the benefits of innovation than primary manufacturers (Klein and Sorra 1996). We therefore suggest the following.

H5: The effect of innovativeness on firm performance will be higher for secondary manufacturers. Firm size has been found to have a positive association with innovation (Murphy et al. 1996; Camisón-Zomoza et al. 2004; Damanpour 1992). This positive association is especially true for incremental (i.e., process) innovation (Cohen and Klepper 1996). Past research in the forest products industry has found that process innovation is the most common type of innovation for this industry (Crespell et al. 2006). Therefore, we hypothesize that the actual implementation of ideas may be moderated by firm size. This leads to our next hypothesis.

H6: Firm size has a positive effect on innovativeness. Studies like Damanpour (1992) and Pierce and Delbecq (1977) argue that the value set of decision makers (management) is a critical moderator variable of the innovation process. In other words, management's attitude towards innovation plays a critical role in predicting a firm's innovativeness. This notion is captured under the construct of managerial attitude toward change, and the following is hypothesized.

H7: Top management's attitude toward change is positively associated with firm innovativeness.

Theoretical frame of reference and operationalization

The proposed model

It is conceptualized in this paper that climate for innovation will have a positive impact on a firm's innovativeness and performance, with innovativeness acting as a mediating variable between climate for innovation and firm performance. The direct effect of climate on performance is hypothesized to be due to its effect on organizational processes, such as problem solving, decision making, communications, coordination, and controlling, as well as psychological processes, such as learning, creating, motivation, and commitment (Ekvall 1996). The conceptual framework of the study is depicted in Fig. 1.

Operationalization

Organizational climate

Organizational climate has seen considerable attention in the literature, and a number of proprietary scales have been developed. Ekvall (1996) was a pioneer in developing an instrument to assess climate for creativity and change (creative climate questionnaire). Later, Ekvall and colleagues developed the situational outlook questionnaire, based on a translation of the creative climate questionnaire and a theoretical framework provided by a model of organizational change (Isaksen et al. 2000). Amabile et al. (1996) developed KEYS, an instrument to assess climate for creativity consisting of eight factors. This development was based on her componential model for creativity (Amabile et al.1996) and explains the relationship between creativity and innovation and the effect of the work environment.

Innovativeness: Innovativeness can be seen as a cultural attribute that captures the openness to new ideas and, hence,

Fig. 1. Theoretical framework of the study showing the study's seven hypotheses (H1–H7).

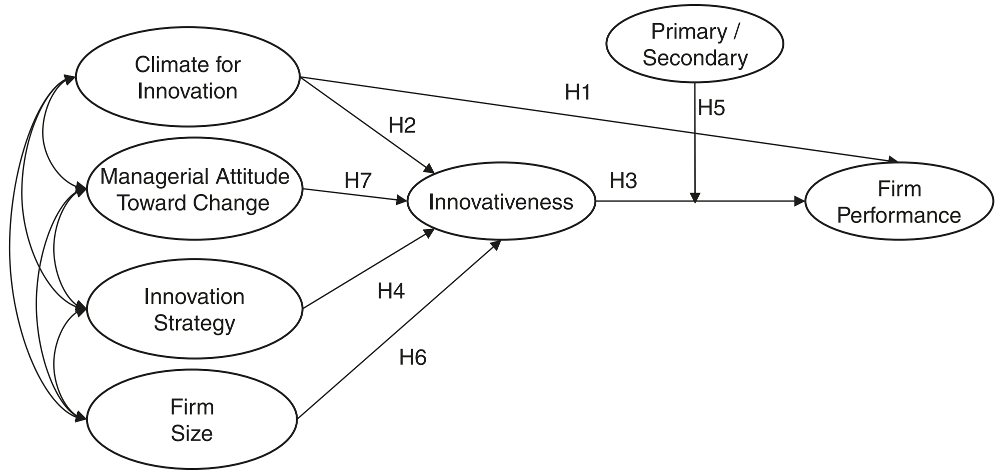


Table 1. Construct operationalization.

Construct	Dimension	Concept description	Scale
Innovativeness	Products, processes, and business systems[a]	Mill or company tendency to adopt or create (dimension types)	1 (strongly disagree) to 7 (strongly agree)
	New product performance[a]	Financial performance of new products as a percentage of revenue, sales growth, and profit	1 (0%–5%) to 7 (>60%)
Managerial attitude toward change	Managerial attitude toward change	Individual interest in pursuing new ideas	1 (strongly disagree) to 7 (strongly agree)
Climate for innovation	Team cohesion, supervisor encouragement, autonomy, challenge, openness to innovation, and resources[a]	Elements perceived by employees known to enhance creativity in the workplace	1 (strongly disagree) to 7 (strongly agree)
Innovation strategy	Products, processes, business systems, and researrch and development expenditure	Degree of integration of innovation in the strategy of the company	1 (very low) to 7 (very high)
Firm performance	Return on sales, sales growth, return on assets, and overall competitiveness	Referred to competitors	1 (lowest 20%) to 5 (top 20%)
Firm size	No. of employees	Actual number at the operation.	1 (1–50) to 4 (>200)
	Sales level	Dollar value for previous year (2005, millions)	1 (1–5) to 6 (>100)

[a]Composite items (four to six items each).

an organization's orientation towards innovation (Hurley and Hult 1998). These new ideas can be in the form of products, services, processes, markets, or organizational changes (Ekvall 1996). Accordingly, following the work of Knowles et al. (2008) we operationalized innovativeness in terms of a firm's propensity to adopt and (or) create new products, new processes, or new business systems.

Innovation strategy: This scale was developed specifically for this study. It consisted of four items assessing the priority a firm places on innovation, defined in terms of the three types explained above (products, processes, and business systems). It also included research and development as a tool to acquire competitive advantage.

Firm performance: Dess and Robinson (1984) advocate for the use of subjective or self-reported scales of firm performance. We asked the respondent to self-rate his or her operation (mill) in relation to its competitors over the last 3 years. This was done to adjust, to some extent, for the expected delay between innovation and financial performance. We used four indicators that represented efficiency, growth, profit, and competitiveness. They were measured as return on sales, sales growth, return on assets, and overall competitiveness.

Managerial attitude toward change: Pierce and Delbecq (1977) argue that, in addition to the structure of a firm, personal attitudes of the decision makers play a fundamental role in predicting innovation. Social psychology usually refers to a similar concept as "ego involvement," which acts as a predictor of change in behavior. Our scale drew from Patchen's (1965) work using six items to assess a manager's attitude toward change.

Firm size: Firm size has traditionally been assessed using sales level (Cohen and Klepper 1996) or number of employees (Evangelista and Mastrostefano 2006). We used both indicators for firm size as they are not just related but also complement each other.

Additionally, we collected information on respondents' experience (years in industry, and years in position). These variables were transformed into categories (e.g., 1–5). Table 1 shows the operationalization of the constructs. The reader is referred to the tables in Appendix A for a detailed list of all items and to Dess and Robinson (1984) and Damanpour (1992) for more details regarding firm performance and firm size, respectively.

Methodology

Questionnaire development

As mentioned above, several scales have already been developed to measure work climate for creativity. However, most of these scales have been constructed to be used in research and development project settings that have professionals in product development as respondents. Consequently, we opted for creating our own scale for each construct, allowing for its use by any kind of respondent at a manufacturing facility. Further, each scale was constructed drawing from past literature and especially tailored to the study's objectives and respondents as a way to ensure reliability and construct validity. Regardless the adjustments, we believe their use is not limited to this particular sector of the industry and can be used in any manufacturing industry.

The questionnaire was pretested with 22 forest industry managers. It was also reviewed by experts in academia and industry. The results were satisfactory, and no major changes were introduced as a result of the pretest.

Sampling, data collection, and response information

A total of 1555 wood product companies in the continental United States were selected for the study. This represents about five percent of all wood products manufacturing companies in the United States. The list was bought from a private company, and firms were selected based on the following criteria: Primary Standard Industrial Classification (SIC) 24xx or 25xx (Wood Products), single manufacturing facility, 50–499 employees, and all sales in the continental United States. Accuracy was around 95% in terms of addresses.

A modified Dillman approach (Dillman 1978) was used for the mailing. In November 2006, a notification letter was sent to all companies, explaining the objectives of the study and the importance of their participation. A URL was also provided, encouraging respondents to complete the questionnaire online. The first set of survey instruments was mailed a few days later. For the first set, each of the 1555 selected companies were sent a questionnaire packet consisting of the questionnaire; a self-addressed, stamped return envelope; and a cover letter that briefly described the purpose of the study and identified the target audience for the questionnaire. The first mailing was followed approximately 1 week later by a reminder postcard

The second set, which was mailed approximately 2 weeks after the reminder postcard, contained a questionnaire packet similar to that of the first set. Approximately 3 weeks later, a reminder letter was sent to all nonrespondent companies. Four weeks after the second reminder, the survey was closed. Overall, the data collection process took 3 months.

An adjusted sample size of 1453 companies resulted, with 219 completed questionnaires returned. Of those 219, a total of 36 questionnaires were completed online. The adjusted response rate was 15.1% with a roughly equal representation of primary and secondary manufacturers.

Data screening

Missing values and normality assumptions

The data set was well balanced, with almost all items missing <2% of cases, so no particular "unfriendly" items were found. Nonetheless, listwise deletion would have meant losing over 40% of the cases. On average, there was aproximately 5% missing data per variable, with multiple random patterns and no apparent systematic pattern. For this reason, we imputed using the expected maximization algorithm for multiple imputation in LISREL version 8.52 (Scientific Sotware International, Lincolnwood, Ill.).

Table 2. Descriptive information of respondents companies and individuals.

Descriptor	Minimum	Maximum	Mean	SD
No. of employees	15	600	109	90
Annual sales ($, millions)	2	84	11	18
Years in industry	1	70	19	13
Years in position	1	65	13	12

In terms of distribution, most composite variables were distributed normally, but several single items were non-normal (skewed). For that reason, we report "robust statistics" that have been scaled to correct some of the non-normality in the data (Byrne et al. 2004). Robust statistics are corrected in the way described by Satorra and Bentler (1994).

Nonresponse bias

Nonresponse bias was tested using the method advocated by Armstrong and Overton (1977). The first 55 respondents (approximately 25%) were compared with the last 55 respondents on innovativeness, work climate, interest in innovation, firm performance, sales level, and number of employees. The results of the independent samples t tests showed no significant differences between these two groups with all p values being above 0.05. A similar analysis was performed comparing online respondents to paper-based respondents. Again, no difference was found between the two groups.

Analysis

Data were analyzed using EQS for Windows version 6.1 (Bentler 2006), and the models tested were correlation structure models with multiple indicators for all latent constructs. Deviations from normality and use of categorical variables to measure firm size led us to analyze the data using robust methods and the polyserial correlation matrix (Bentler 2006; Satorra and Bentler 1994). Hence, all reported results are based on robust methods. A special consideration for this type of analysis is that fit indices regularly used are not as meaningful. Bentler (2006) recommends the use of the Yuan–Bentler residual-based F test and argues that this is the "best single test currently available to evaluate models under general conditions," such as small sample size or deviations from normality. The Satorra–Bentler scaled chi-square is also recommended and, hence, reported. Some collinearity among dimensions was expected; however, excessive levels compromise the discriminant validity of the constructs and reduce power when estimating using maximum likelihood. Consequently, this issue was constantly monitored.

Results

Response information

The study's sample size is acceptable, being >200 and roughly five times the number of free parameters being estimated (45) (Bentler and Cho 1988). A larger validation sam-

Table 3. Pearson's correlation coefficients, means, and standard deviations for the manifest variables (n = 219).

		Climate for innovation						Innovation strategy			
Variable	Label	1	2	3	4	5	6	7	8	9	10
1	Team cohesion		0.75**	0.34**	0.58**	0.64**	0.58**	0.37**	0.40**	0.21**	0.33**
2	Supervisor encouragement			0.33**	0.52**	0.62**	0.60**	0.29**	0.30**	0.20**	0.32**
3	Autonomy				0.09	0.44**	0.42**	0.21**	0.14*	0.14*	0.18**
4	Resources					0.47**	0.27**	0.37**	0.39**	0.13	0.32**
5	Openness to innovation						0.54**	0.35**	0.39**	0.33**	0.42**
6	Challenge							0.44**	0.37**	0.24**	0.44**
7	Innovation strategy products								0.65**	0.31**	0.63**
8	Innovation strategy proceses									0.37**	0.54**
9	Innovation strategy business systems										0.38**
10	Innovation strategy research and development										
11	No.of employees										
12	Annual sales										
13	Managerial attitude 1										
14	Managerial attitude 2										
15	Managerial attitude 3										
16	Managerial attitude 4										
17	Managerial attitude 5										
18	Managerial attitude 6										
19	Innovativeness products										
20	Innovativeness processes										
21	Innovativeness business systems										
22	New product performance										
23	Return on sales										
24	Sales growth										
25	Return on assets										
26	Overall competitiveness										
	Mean	5.18	5.30	4.27	5.31	4.59	4.86	4.85	5.05	3.99	4.10
	SD	1.01	0.97	0.90	0.89	1.03	1.05	1.43	1.40	2.32	1.61

Note: *Correlation significant at the 0.05 level; **correlation significant at the 0.01 level. Shaded values represent different constructs.

[a]Ordinal variables. Values reported correspond to polychoric covariances with interval variables and polychoric correlation between ordinals.

ple would provide a sound and logical follow-up to this study.

Descriptive information

One hundred fifteen companies could be classified as primary manufacturers, including sawmills, plywood mills, particle board mills, and others. One hundred and one companies could be classified as secondary manufacturers, including millwork, furniture, cabinetry, and windows and doors. Forty states were represented in the sample. California and North Carolina returned the greatest number of cases (28 and 16, respectively). Most respondents were either plant managers or executives, with several owners responding as well. Table 2 summarizes descriptive information of the respondents. Intercorrelations, means, and standard deviations for the study's 26 manifest variables are presented in Table 3.

The present analysis followed a two-step procedure based on the approach recommended by Anderson and Gerbing (1988). In the first step, confirmatory factor analysis was used to develop a measurement model that demonstrated an acceptable fit to the data. In step two, the measurement model was modified so that it came to represent the theoretical (causal) model of interest. This theoretical model was then tested and revised until a theoretically meaningful and statistically acceptable model was found.

Model refinement

The measurement model

The model investigated in this study consisted of six latent variables, corresponding to the constructs of the innovativeness–performance model: work climate for innovation, innovation strategy, innovativeness, managerial attitude toward change, and firm performance, plus firm size acting as a moderator of the relationship between innovativeness and firm performance. Each of the five latent variables was measured by at least four manifest indicator variables (Table 1). The chi-square value for the initial measurement model was statistically significant, indicating a less than perfect fit. A number of other results, such as fit indices and psychometric indicators, suggested that there was in fact a problem with the model's fit. "New product performance," a composite variable used as an indicator for innovativeness, exhibited low t values and high error variances and, consequently, was eliminated from the measurement model. The same was true for one of the indicators (business systems) of the construct innovation strategy, and this was deleted as well.

Size[a]		Managerial attitude						Innovativeness				Firm performance			
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
0.12	0.02	0.28**	0.05	0.08	0.16*	0.20**	0.16*	0.35**	0.47**	0.38**	0.06	0.20**	0.22**	0.24**	0.37**
0.12	–0.03	0.26**	0.08	0.04	0.19**	0.17**	0.16*	0.34**	0.44**	0.41**	0.05	0.24**	0.22**	0.28**	0.35**
0.03	0.03	0.11	0.03	0.15*	0.02	0.06	0.09	0.18**	0.16*	0.19**	0.13	0.16*	0.12	0.23**	0.23**
0.04	0.02	0.19**	0.00	–0.06	0.05	0.08	0.08	0.31**	0.39**	0.31**	0.08	0.11	0.10	0.16*	0.22**
0.15	–0.01	0.23**	0.05	0.05	0.13*	0.17*	0.18**	0.29**	0.38**	0.40**	0.08	0.24**	0.26**	0.25**	0.33**
0.14	0.01	0.18**	0.11	0.11	0.16*	0.23**	0.21**	0.41**	0.44**	0.39**	0.15*	0.21**	0.20**	0.21**	0.26**
0.19	0.11	0.16*	0.15*	0.15*	0.11	0.11	0.12	0.56**	0.44**	0.38**	0.37**	0.23**	0.18**	0.20**	0.25**
0.25	0.16	0.18**	0.06	0.03	0.04	0.08	0.12	0.43**	0.54**	0.42**	0.24**	0.20**	0.23**	0.22**	0.27**
0.22	0.10	0.22**	0.14*	0.23**	0.12	0.18**	0.16*	0.28**	0.31**	0.46**	0.25**	0.14*	0.19**	0.18**	0.21**
0.12	–0.04	0.19**	0.14*	0.08	0.10	0.16*	0.18**	0.55**	0.49**	0.46**	0.30**	0.18**	0.26**	0.19**	0.22**
	0.62	0.10	0.00	0.02	0.08	–0.02	0.12	0.26**	0.26**	0.25**	0.05	0.26**	0.36**	0.26**	0.23**
		–0.04	–0.12	–0.04	0.02	–0.15	0.01	0.06	0.10	0.06	–0.07	0.22	0.14	0.17	0.08
			0.22**	0.24**	0.21**	0.51**	0.43**	0.44**	0.47**	0.45**	0.22**	0.13	0.14·	0.10	0.20**
				0.56**	0.49**	0.14*	0.14*	0.21**	0.24**	0.19**	0.17**	0.00	0.05	–0.01	0.06
					0.38**	0.09	0.14*	0.25**	0.21**	0.20**	0.24**	–0.03	0.05	–0.03	–0.05
						0.34**	0.20**	0.248*	0.25**	0.20**	0.00	0.09	0.07	0.06	0.16*
							0.59**	0.338*	0.34**	0.28**	0.16*	0.08	0.08	0.02	0.13
								0.36**	0.38**	0.34**	0.16*	0.03	0.10	–0.01	0.06
									0.81**	0.70**	0.38**	0.19**	0.318*	0.19**	0.32**
										0.79**	0.26**	0.26**	0.28**	0.26**	0.36**
											0.24**	0.26**	0.30**	0.30**	0.36**
												0.00	0.10	–0.03	0.09
													0.49**	0.77**	0.60**
														0.54**	0.54**
															0.69**
2.37	2.09	5.34	5.25	4.80	5.64	5.42	5.48	4.58	4.81	4.23	2.77	3.48	3.56	3.39	3.85
0.86	1.01	1.27	1.37	1.43	1.42	1.40	1.58	1.19	1.12	1.18	1.66	1.13	1.17	1.18	1.01

More importantly, the scale for managerial attitude toward change showed a composite reliability value of 0.68 and a variance extracted of 0.28; both values were below the cut-off points of 0.7 and 0.5, respectively.[2] Consequently, we deleted this factor from the model and moved on to analyze an alternative five-factor model, with all hypotheses remaining, except for the seventh hypothesis.

In the case of the firm performance construct, Lagrange modification index values suggested adding an error covariance between "return on sales" and "return on assets," with a decrease in chi-square of 21.2. This covariance term makes methodological sense given the closeness of both financial indicators. This closeness may be causing respondents to regard them as similar, causing the correlation of specific, repeatable errors (Gerbing and Anderson 1984). In a study looking at market orientation, strategy, and performance in the forest products industry, Hansen et al. (2007) allowed these two terms to covary. As a last step, we validated this covariance on an independent sample collected by Knowles et al. (2008), and we found the same relationship, with the Lagrange multiplier indicating a decrease in chi-square of 24.0 by adding the term. Consequently, we added this term and estimated a correlation of 0.48 ($p < 0.05$).

Table 4 shows the loading coefficients and error variances for all manifest variables of the revised measurement model. The t scores ranged from 4.5 to 47.3, indicating that all factor loadings were significant ($p < 0.001$). These results support the convergent validity of the indicators (Anderson and Gerbing 1988). Table 5 provides the composite reliability and Cronbach's alphas for each construct. All scales demonstrated acceptable levels of reliability, with coefficients in excess of 0.70.

Table 5 also provides the variance-extracted estimate for each scale. Three of the four factors demonstrated a variance-extracted estimate in excess of 0.50, the minimum level recommended (Fornell and Larcker 1981). However, this test is very conservative. Nonetheless, because these scales have not been used previously, it is not surprising to find a scale with moderate levels of variance extracted. This suggests that further scale development work is needed for the climate for innovation scale. Combined, these findings generally support the reliability and validity of the constructs and their indicators. Table 5 also shows the correlation matrix and descriptive statistics for all constructs.

The revised model

After stage 1 was completed (measurement model confirmatory factor analysis), a new simplified model was analyzed, including only those scales that showed good

[2] Since we did not pretest this scale on owners, this group had problems that involved communication with superiors. This could easily be corrected in future studies via a better wording of some items.

Table 4. Parameter estimates for measurement relations.

Construct	Indicator	Standard loading	t^a	SE	R^2
Firm performance	Return on sales	0.71	8.1	0.70	0.50
	Sales growth	0.68	10.0	0.74	0.46
	Return on assets	0.81	14.1	0.59	0.65
	Overall competitiveness	0.84	18.9	0.54	0.71
Innovativeness	Products	0.86	15.8	0.52	0.73
	Processes	0.95	46.8	0.31	0.90
	Business systems	0.84	19.8	0.55	0.70
Innovation strategy	Products	0.82	16.3	0.58	0.67
	Processes	0.81	16.3	0.59	0.66
	Research and development	0.75	12.0	0.67	0.56
Climate for innovation	Team cohesion	0.88	27.7	0.47	0.78
	Supervisor encouragement	0.84	16.2	0.55	0.70
	Autonomy	0.39	4.3	0.92	0.15
	Resources	0.64	8.3	0.77	0.41
	Openness to innovation	0.75	15.9	0.66	0.56
Firm size	No. of employees	1.00	8.5	0	1.0
	Annual sales	0.62	7.5	0.79	0.38

[a]Robust *t* value.

psychometric properties in the previous step (all but managerial attitude toward change). The resulting model included climate for innovation (all dimensions but challenge, which was deleted based on the Wald test), innovativeness, innovation strategy, firm size, and firm performance. Because of excessively high correlation among some pairs of dimensions (collinearity), the subscales for climate for innovation and innovativeness were converted into individual, composite variables. This model showed acceptable fit (Hu and Bentler 1999) (Satorra–Bentler $\chi^2_{126} = 196.0$ ($p < 0.01$); Yuan–Bentler F test = $0.85_{126,\,89}$ ($p = 0.80$); comparative fit index = 0.93; non-normed fit index = 0.92; incremental fit index = 0.93; parsimony-normed fit index = 0.70; χ^2/df = 1.8; standard round mean residual = 0.061; root mean standard error of approximation = 0.060, 95% CI = 0.046–0.074).[3] All standardized residuals were closely centered on zero (±0.2) suggesting the absence of major model misspecifications. Power for this model was above the recommended level of 0.8. When including correlated errors, coefficient rho is the best indicator of overall reliability (Bentler 2006). The model exhibited a value of 0.93 for rho, indicating high reliability.

At this point, we also addressed the issue of discriminant validity between constructs. Following Fornell and Larcker's (1981) approach (using R^2 and variance extracted), we found that all pairs showed discriminant validity. A constrained versus free chi-square test confirmed these results.

Because of the removal of one endogenous latent variable (managerial attitude toward change), the R^2 for innovativeness went down from 65% to 51%, whereas performance remained the same (24%), with respect to the initial five-factor theoretical model. This outcome is desirable, because the model is explaining an important proportion of the variance of the dependent variables.

Given the satisfactory fit of the model, the hypotheses were evaluated by examining the estimated structural path coefficients. To test moderating effects (the fifth hypothesis) and following Baron and Kenny (1986), we first divided the data set into ‘‘primary manufacturers’’ and ”secondary manufacturers.” In the first step, the parameter from innovativeness to firm performance was constrained to be equal between the two groups. In the second step, the parameter was allowed to be free. The chi-square test (1 df) revealed a significant difference at the 5% level ($p = 0.035$) between both groups for the relationship between innovativeness and financial performance, which supports the fifth hypothesis. This effect was equal to 0.07 for primary manufacturers, whereas it was 0.42 for secondary manufacturers. This finding can be seen as an interaction effect between innovativeness and type of manufacturer measured in terms of performance.

This finding suggests that secondary manufacturers may be better positioned to turn innovativeness into financial performance. Hypotheses one through five were supported by the results, whereas the sixth hypothesis was partially supported ($p < 0.1$). Hypothesis 7 could not be tested because of the elimination of the relevant factor. Climate for innovation, firm size, and innovation strategy affect innovativeness. Innovation strategy has the strongest effect, as shown by the value of the coefficients. Innovativeness acts as a mediator variable between innovation strategy and firm performance. Climate for innovation has a direct effect of 0.28 and an indirect effect (via innovativeness) of 0.07 on firm performance, totaling 0.35. The indirect effect of innovation strategy on firm performance via innovativeness is 0.14. To test for the significance of these indirect effects, we followed the bootstrapping method advocated by Shrout and Bolger (2002). We based this choice on sample size and evi-

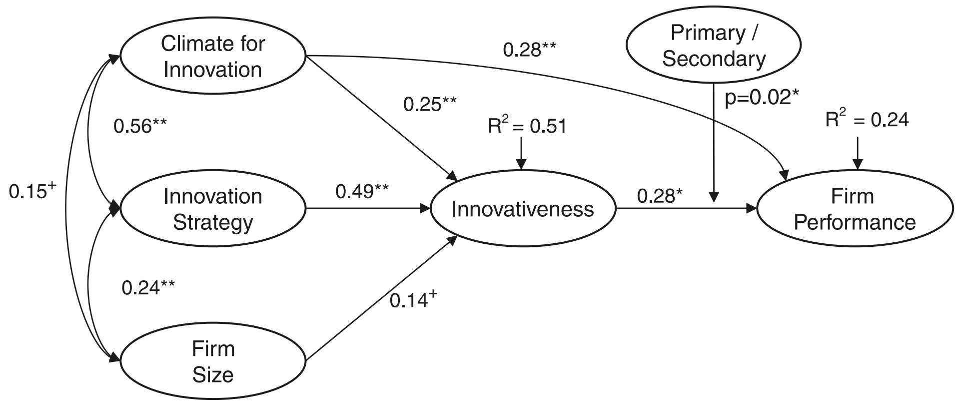
[3] A p value greater than alpha indicates a good fit for the Yuan–Bentler F test. The four indices, standard round mean residual, and root mean standard error of approximation are all robust estimators as defined earlier in the text.

Table 5. Descriptives and correlation matrix for interval variables (n = 219).

	Descriptive statisitc					Correleation coefficient		
Variable	Mean	SD	CR	Alpha	VE	CI	IS	IN
Climate for innovation (CI)	4.93	0.47	0.78	0.83	0.44			
Innovation strategy (IS)	4.67	0.50	0.76	0.82	0.51	0.56**		
Innovativeness (IN)	4.54	0.29	0.84	0.91	0.63	0.55**	0.67**	
Firm performance	3.57	0.20	0.78	0.86	0.47	0.43**	0.37**	0.43**

Note: Firm performance was measured on a five-point interval scale and the remaining variables were measured on a seven-point interval scale. CR, composite reliability; VE, variance extracted. **p < 0.01.

Fig. 2. The structural revised model with robust parameters. Standardized path coefficients are shown beside the single-headed arrows and correlations are shown beside the curved double-headed arrows. $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.



dence of non-normality for the standard error of the indirect effects. These issues result in a loss in power to detect mediation. We created 1000 bootstrap or pseudo-samples of size 210.[4] Then, we estimated empirical indirect effect means and standard errors for all three indirect effects. The results indicated that the indirect effect of innovation strategy on firm performance via innovativeness was significant (b = 0.116 (95% CI 0.001–0.231), $\beta = 0.49 \times 0.28 = 0.137$). None of the other two indirect effects was significant, because they included zero in the 95% confidence interval. Furthermore, we followed Baron and Kenny's (1986) approach to examine the mediation role of innovativeness. The direct effect of innovation strategy on firm performance disappeared when controlling for innovativeness, suggesting full mediation of the relationship by innovativeness. Firm size and climate for innovation showed to be only partially mediated by innovativeness, although as explained above, those indirect effects were not significant.

One caveat of these kinds of models (including variables prior to the independent and dependent variables) is that some associations may be at least partially spurious, and any claim of causality must be made with caution (Davis 1985). This is the case of the association between innovativeness and firm performance (both affected by climate for innovation). To shed light on this issue, we looked at an alternative model where the path from climate for innovation to firm performance was dropped. The resulting model showed good fit, and the path from innovativeness to firm performance remained significant, with a t value of 3.8 (p < 0.01), which supports the claim of causality between innovativeness and firm performance. Figure 2 shows the structural revised model and its robust parameter estimates.

Discussion and implications

Theoretical contributions

The modified hypothetical model was supported by the data. This is important, because it puts innovativeness as an organizational element that can be affected by managerial practices and result in a favorable work climate for innovation. Climate for innovation, defined as a work climate characterized by high levels of autonomy, cohesion, support, openness to new ideas and risk, challenge and resources, affects the degree of openness to change of a firm. Furthermore, a climate for innovation is likely to improve organizational efficiencies and reduce inefficiencies, as evidenced by our findings of its positive effect on firm performance. This study proposes a theoretical framework that helps to understand some of the antecedents and effects of innovativeness and fills a gap in the past literature where most studies focused on bivariate relationships. The proposed model integrates and extends past research and that found positive relationships between organizational culture, innovativeness, and firm performance. Innovation, the actual behavior, is better understood by identifying a specific type of organizational climate and strategy that act as antecedents to innovativeness. This model proposes that innovation is the result of creating an environment that encourages risk taking and experimentation. It comes from organizations that structure themselves around innovativeness and are

[4] Of the 1000 pseudo-samples, 998 converged.

guided by a competent management that is willing and able to champion innovation.

Managerial implications

The positive effect of work climate and innovation strategy on innovativeness and firm performance calls for managers to act and capitalize on effective interventions. Upper management should seek team cohesion by aligning people around a clear vision for the organization and giving them a sense of purpose. Supervisors and middle managers should be continually trained to improve their people skills, so they can play the supportive role that fosters creativity among employees. Upper management should make clear that innovativeness is a core value of the organization and act accordingly. This means encouraging risk taking and idea time (i.e., brainstorming), along with setting an effective system to collect ideas and follow them through until implementation. Employees should be given a reasonable amount of freedom and resources to exercise their creativity and explore new paths. A potentially effective way to promote this is by challenging them. This can be accomplished with simple actions like job rotation or goal stretching and by making continuous improvement a way of being, so the challenge goes beyond the task and focuses on the overall improvement of the operation.[5] Besides the above-mentioned climate factors, upper management must incorporate innovation deeply into its strategy by aligning all resources, structures, and functions around it. It also follows that the ability to foster and lead such a work environment must be a trait to seek for during management selection and training.

All these improvements are expected to positively affect firm performance in terms of sales growth and profitability, especially for secondary manufacturers who seem to be better positioned to capitalize on a favorable attitude toward change. Potential sources of higher profitability may be lower costs, price premiums, better quality, and higher market share among others.

It is a common notion to believe that innovation comes at a great expense and that the high rates of failure frequently offset the potential benefits. We believe that to be true to some extent for highly innovative companies or entrepreneurs. They tend to focus on radical innovations that, by definition, often involve a higher risk and higher capital demands. However, as this study's findings suggest, investing in the organizational climate may positively affect innovativeness and performance, without large capital investments.

Studies like this can help managers to realize the innovation imperative and the wealth of knowledge they have at their disposal within the workforce, just waiting to be exploited. Scales like the ones presented here and others commercially available should be increasingly used by managers to benchmark their operations and track the effects of organizational changes.

Limitations and recommendations for further research

As with all cross-sectional studies, caution must be used when implying causality among factors. Time dependence is necessary to claim causality, and hence, longitudinal studies are needed. In the present study, we only show associations that make theoretical sense and that may suggest causality. Our assessment of organizational climate is based on managers' perceptions. Some studies have warned against this practice, because managers arguably perceive the climate as significantly more creative than nonmanagers (Patterson et al. 2004). Nonetheless, several reasons led us to follow this approach: (*i*) we were not interested in absolute values, but rather in the associations among constructs; (*ii*) practical reasons make the one-respondent approach less cumbersome and, hence, more likely to deliver useful results; and (*iii*) we consider climate to be an attribute of the organization that can be assessed by someone who is permanently exposed to it, and managers who get to see the whole picture make better prospects for this task.

The final model was based on data-driven model modifications and, therefore, must be regarded as tentative until the results are validated with an independent sample and against other instruments. Further research should include adequate scales for individual and organizational well-being constructs, such as job satisfaction and organizational commitment, to allow the assessment of a nonrecursive model, where performance and climate provide feedback to those antecedent constructs. Future research should refine all of the scales used in this study, especially managerial attitude toward change, which we dropped here because of its low values for reliability and variance extracted. This development would help to better understand the role of management in fostering a climate for innovation. Similarly, the scale used to assess innovativeness remains to be validated, because it was developed using the US sawmilling industry. This study looked at an intraorganizational system, but future research could also include the external environment and its interaction with the organization. This could be done via assessing constructs, such as market orientation and networking, and (or) controlling for external conditions, such as market turbulence. Sample size considerations suggest the use of larger samples. In our case, this issue mostly reduces power in the moderator effect tests where we split our sample in halves.

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[5] This idea was taken from previous findings of this study, where in-depth case studies and qualitative interviews were performed.

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Appendix A. Scales used in the study

Table A1. The climate for innovation measure (Amabile et al. 1996).

Factor and item	Description
Supervisor encouragement	
1	People ignore what their superiors expect from them[a]
2	People do not feel encouraged by their superiors to do creative work[a]
3	People feel that top management is enthusiastic and confident about their work
4	Supervisors support their teams within the organization
Resources	
5	If people need information to do their work, it is readily accessible within the organization
6	Generally, people can get the resources they need for their work
7	It is difficult for people to get the resources they need to do their work[a]
8	People have too much work to accomplish in the allotted time[a]
Team cohesion	
9	Teams are committed to their work
10	People feel they cannot trust their coworkers[a]
11	Communication is free and open within teams
12	Employees overall lack a shared vision of where we are going and what we are trying to do[a]
Openness to innovation	
13	People are encouraged to take risks even if it results in failure
14	New ideas are generally resisted[a]
15	It is often difficult to carry out organizational changes[a]
16	Innovation is rewarded
Challenge	
17	People do not feel challenged by their work[a]
18	People have the feeling that their work is important
19	The nature of our work calls for continuous learning or training
20	Most tasks at work are easy to execute[a]
Autonomy	
21	People feel like they do not have control over their own work[a]
22	People have the freedom to decide how they are going to do their work
23	Employees determine their own work
23	People do not have a say in the way their job is performed[a]

[a]Item needs to be reversed.

Table A2. The managerial attitude toward change measure (Patchen 1965).

Item	Description
1	If I try to change the usual way of doing things, it usually turns out worse[a]
2	I usually prefer doing things pretty much in the same way[a]
3	It is usually better to let my superiors (board or upper management) worry about new or better ways of doing things[a]
4	I often try out, on my own, a better or faster way of doing something on the job
5	I often get chances to try out my own ideas on my job
6	In the past year, I have on different occasions suggested to my boards of directors or upper management a different or better way of doing something on the job

[a]Item needs to be reversed.

Table A3. The innovativeness measure (Knowles et al. 2008).

Item	Description
1	Our company tends to be an early adopter of new products
2	Our company actively seeks new business systems from outside this organization
3	Our company actively develops in-house solutions to improve our manufacturing processes
4	Our company actively develops new products in-house
5	Our company tends to be an early adopter of new manufacturing processes
6	Within our company, we are able to implement new business systems used by other organizations
7	Our company actively seeks new products from outside this organization
8	Our company sees creating new products as critical to our success
9	Within our company, we are able to implement new products used by other organizations
10	When it comes to creating new processes, our company is far better than the competition
11	Our company tends to be an early adopter of new business systems
12	Our company sees creating new business systems as critical to our success
13	When it comes to creating new products, our company is far better than the competition
14	Our company sees creating new manufacturing processes as critical to our success
15	Our company actively develops in-house business systems solutions

Table A4. The innovation strategy measure (new).

Item	Description
1	We give priority to product innovation
2	We give priority to innovation in manufacturing processes
3	We give priority to innovation in business systems
4	We give priority to research and development to gain a competitive advantage