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Antecedents to Innovativeness in the Forest Products Industry

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ABSTRACT

In this study, managers and hourly workers from three Oregon forest products companies provided their perspectives on phenomena that lead to firm innovativeness. A total of 198 valid responses were obtained. Scales were adapted from past research to measure two antecedents to employee perceptions of firm innovativeness (organizational commitment and climate for innovation, the former acting as a second-order mediating factor). A discussion of scale properties is provided, followed by a brief comparison among companies regarding the factors that promote and prevent innovation in the workplace. The scales were found to be reliable and possess discriminant validity. The measurement model showed adequate fit and positive correlations among the constructs and provided support for the theoretical model. These findings suggest that companies can increase their innovativeness by fostering a favorable work climate. The effect of work climate on innovativeness is mediated by higher levels of organizational commitment.

Keywords: innovativeness, innovation, organizational climate, organizational commitment

Introduction

In an increasingly competitive marketplace, the need for new ideas has become more critical than ever. Today, information is readily accessible worldwide, in real time. The global village is no longer a bold thought but rather a reality, with competitors coming from new and unexpected places. Furthermore, new substitute products and applications threaten wood products and may represent tougher competitors than other companies within the forest products industry. Therefore, it is necessary to explore new sources of competitive advantage. Companies are realizing that intangible assets, such as a motivated and creative workforce, have become crucial competitive advantages in this new knowledge-based environment (Korhonen 2006, Sveiby 2001).

The forest products industry has a reputation for being conservative, but recently major changes have been observed (Hansen and Juslin 2006). A production orientation has allowed the industry to make notable progress in process innovation, maximizing yield and recovery to outstanding levels (Hamner et al. 2006). This approach makes sense when one looks at the cost breakdown of primary forest products, where raw materials can represent up to 80 percent of total production costs (Siry et al. 2006). An exclusive focus on process innovation, however, is likely insufficient for long-term success for primary manufacturers as well as for secondary, value-added manufacturers.

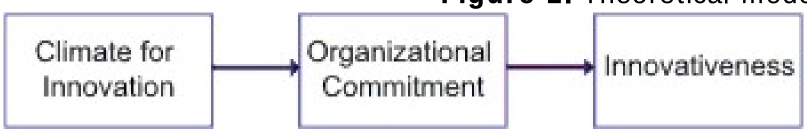
Creativity, innovativeness, and innovation are all related concepts, sometimes used interchangeably and widely studied by a variety of disciplines, in a wealth of settings. The forest products industry is no different from other industries where increased levels of competition demand that companies reinvent themselves in order to thrive or even survive. Organizational climate has been long recognized as the practical and readily observable face of an organization's culture (Cameron and Quinn 1998). Substantial research has been devoted to identifying the link between climate and innovation (Ekvall and Ryhammar 1999, Isaksen et al. 2000).

Study Framework and Objective

The main objective of this study was to gain a better understanding of several antecedents to innovativeness in the work place. It is hypothesized that the way employees perceive their organization may affect their actual behavior. It is expected that employees who see their employer as innovative are more likely to feel encouraged to embark on innovative behaviors.

Accordingly, a model relating climate for innovation, organizational commitment, and innovativeness is proposed and preliminarily evaluated (**Fig. 1**).

Figure 1. Theoretical model.



Climate for innovation and organizational commitment act as antecedents to innovativeness, with organizational commitment mediating between climate for innovation and innovativeness. It is proposed that the organizational environment can affect the degree of identification, loyalty, and involvement that employees feel for their employer. Furthermore, given a favorable climate for innovation,[1] a high degree of commitment implies a positive disposition toward the organization and a favorable perception of its degree of innovativeness. The construct of innovativeness is understood as being favorable toward creating and/or adopting new products, processes, and business systems. As a characteristic of a firm, it is highly relevant to understand the antecedents to innovativeness. This model is explained in detail in the section below.

(1) As operationalized in this study.

Theoretical Background

The following section familiarizes the reader with the theoretical framework for the study (**Fig. 1**). First, the literature is reviewed to define nuances among the concepts of creativity, innovation, and innovativeness. This is followed by descriptions of the antecedents to innovativeness under study: organizational commitment and climate for innovation.

Creativity, Innovation, and Innovativeness

The measurement of creativity, innovation, and innovativeness are topics of research in a wide variety of disciplines (Hauser et al. 2006). While traditional psychology has concentrated on individual creativity (e.g., the classic work by Torrance 1962 or more recently Sternberg 2006), organizational researchers and sociologists have studied innovation more broadly, either at the group or organization level. Notable examples include Cooper and Jayatilaka (2006) on group creativity and motivation in the workplace, West and Farr (1989) and West et al. (1996) on innovation at work, and Amabile (1983) and Amabile et al. (1996) on individual and organizational creativity and motivation. Innovation has also been studied by type (e.g., radical vs. continuous, rates of adoption (Rogers 1962)) and several other factors.

As previously stated, creativity, innovativeness, and innovation are all related concepts, with fuzzy boundaries. Rogers (1954) defined creativity as " ... the emergence in action of a novel relational product, growing out of the uniqueness of the individual on the one hand and the materials, events, people, or circumstances of his life on the other." It can be seen that even from early definitions, creativity was understood to be a function of individual characteristics and the environment. Leonard and Swap (1999) define creativity as "a process of developing and expressing novel ideas that are likely to be used."

The same authors also define innovation as the "embodiment, combination and/or synthesis of knowledge in novel, relevant, valued new products, processes or services." In summary, creativity can be seen as the ideation component of innovation and innovation as encompassing both the proposal and implementation of new ideas. Amabile et al. (1996) and West and Farr (1990) emphasize the notion of appropriateness of the idea. This also includes the intentionality of benefit. In other words, an innovation is an idea that gets implemented with the goal of getting benefits. Studies such as those of Klein and Sorra (1996), Klein et al. (2001), and Klein and Knight (2005) elaborate on this idea, introducing the concept of "innovation effectiveness."

It is not necessary, however, for all innovations to be creative as in the case of adoptions of widespread technologies. Also, innovation is change, but not all change is innovation (West and Farr 1990). Hurley et al. (1998) define innovativeness as the openness to new ideas or a firm's orientation toward innovation. Current approaches in the forest products industry define innovativeness as the propensity of organizations to adopt and/or create innovations in the form of products, services, processes, and business systems (Knowles et al. 2008). This study uses this definition and operationalization of innovativeness.

In the case of the forest products industry, Fell et al. (2003) propose a hybrid scale to measure innovativeness that captures two previously used measures of innovativeness, namely the time of adoption (Rogers 1954) and the degree of adoption of a new product (Midgley and Dowling 1978, Robertson 1971). Crespell et al. (2006) used a three-item scale to measure product, process, and business systems innovativeness in the forest products industry. Other efforts to study innovativeness in the forest products industry include Välimäki et al. (2004), Lee et al. (1999), and West and Sinclair (1992), with one study specifically designed to develop a scale for measuring innovativeness in the forest products industry (Knowles et al. 2008).

Antecedents to Innovativeness

Damanpour (1991) conducted a meta-analysis of studies on organizational innovation and its determinants and moderators. Managerial variables, as well as organizational climate variables, were found to be significantly correlated with organizational innovation, acting as determinants. Managerial variables included 'administrative intensity,' 'managerial tenure,' and 'centralization,' the latter with a negative relationship. Among the climate variables, resource availability was among the most important variables. It was operationalized in two ways: as technical knowledge and as financial 'slack' resources to afford the innovation process. Overall, managerial tenure, slack resources, and internal communications explained more than 60 percent of the variance in innovation.

Several studies have found innovativeness to act as a mediator between organizational culture and firm performance (Hult et al. 2004, Calantone et al. 2002, Deshpande et al. 1993).

Similarly, Amabile's (1983, 1997) componential theory of individual/team creativity is useful for illustrating how organizational commitment and climate for innovation can positively impact firm innovativeness. The model states that elements of the work environment will impact an individual's creativity. Motivation is the component that is affected the most by the work environment, through its impact on 'role perception' (Lawler and Porter 1967). Therefore, the model proposes that innovation is a direct result of the creativity of individuals and its interaction with the work environment. Most importantly for this study, it is suggested that psychological perceptions of a firm's innovativeness are likely to impact the motivation to generate new ideas (Amabile et al. 1996).

Organizational Commitment

Organizational commitment has mostly been conceptualized as a multidimensional construct. Three types of commitment are the most common: affective, continuance, and normative (Meyer and Allen 1984, 1997). Affective commitment is driven by intrinsic motivation and involves an individual's identification and attachment to the organization. Continuance commitment is extrinsically motivated and involves the desire to maintain membership in an organization based on the perceived costs of leaving (e.g., lack of alternatives, loss of benefits) (Johnson and Chang 2006). Normative commitment involves a sense of bond or debt to the organization. This type of commitment is the subject of current debate regarding its validity, and it does not seem appropriate for this sample so it was not included in this study. Based on the classic study by Mowday et al. (1979), Cook and Wall (1980) operationalized affective commitment using three dimensions: loyalty, identification, and involvement and used them to assess commitment among blue collar workers.

The mediating role of organizational commitment has been recognized by several studies. Westerman and Cyr (2004) used it as a mediator between an individual's values/personality congruence and behavior (intention to remain). Similarly, Hunt and Morgan (1994) conclude that a global organizational commitment construct mediates the effect of constituency-specific commitments (to work groups, supervisor, and top management) and several organizational outcomes. They conceptualized organizational commitment as a three-dimensional construct (internalization, compliance, and identification).

Shipton et al. (2006) investigated the relationship between aggregate job satisfaction and organizational innovation and found a positive association. They explain the association as being due to higher degrees of employee endorsement toward innovations due to higher levels of morale. Similarly, Swailes (2000) states that, as a result of macro-level changes in the workplace, linkages between employees and the organization change. As a consequence, commitment results in team work, creativity, and innovative behavior. This new view of the construct is especially true for professional jobs, where payment may be linked to performance and contribution, or where job stability is low. We speculate, however, that the current hardships that the forest products industry is facing may induce this kind of behavior among blue collar employees as well.

De Brentani and Kleinschmidt (2004) link managerial commitment in the international new product development (NPD) effort with innovation and performance. Similarly, Fukugawa (2006), studying networks in Japan, links commitment to innovation in the form of NPD. McMurray et al. (2004) conclude that organizational commitment in Australian manufacturing was a second order construct with two first order factors: ‘attachment’ and ‘detachment’. Attachment was composed of elements relating to both normative and affective dimensions of commitment, while detachment only included normative elements, as in Allen and Meyer (1990). These researchers found a positive association between organizational commitment and a type of organizational climate very similar to the climate for innovation used in this study. Their four dimensions were recognition, autonomy, support and trust, and cohesion.

Perception is the first aspect of behavior. Other key elements are personality and expectations (Rummel 1976). Our actions respond to an anticipation of certain consequences or effects of those actions, weighting our dispositions (Kelly 1963). It is reasonable to expect that a committed employee, who cares for their employer’s performance and who perceives it as innovative will engage in innovative behaviors anticipated to benefit the organization.

In summary, we argue that in order to go from idea to innovation, many actions must be taken, reaching different circles of influence and power. This demands focus and drive, something that can be expected only from a person who is committed to their organization.

Accordingly, a scale to assess individual organizational commitment is included in this study.

Climate for Innovation

Organizational culture is seen as the common set of symbols, rules, thoughts, values, and beliefs that individuals from an organization share and use to give meaning and order to their experience (Deshpande and Webster 1989, Feldman 1986). Organizational culture results in what is called organizational climate and in the case of this study, climate for innovation. Certain cultures will produce climates more likely to foster innovativeness (Damanpour 2001).

In terms of theoretical background, this study subscribes to the componential model of organizational creativity and innovation by Amabile (1983, 1997) to assess climate for innovation. Her theories are based on the principle that although personality plays a role in intrinsic motivation, the social environment can significantly impact a person’s level of intrinsic motivation and hence their creativity. Amabile’s componential model of creativity includes three major components of individual or team creativity: expertise, creative-thinking skill, and intrinsic task motivation. The theory predicts that creativity occurs when these three components overlap and that it will be higher as the three components increase. Amabile's model, however, includes the 'basic orientation of the organization toward innovation' (Innovativeness) as a part of the work environment and operationalizes it via organizational encouragement and organizational impediments. This study considers innovativeness as a separate construct from work environment and includes encouragement (from supervisors) as a dimension of climate (Koys and DeCottis 1991; Anderson and West 1996, 1998).

Patterson et al. (2005, 2004) developed a measure for organizational climate. The measure consists of 17 scales, one of which is 'innovation and flexibility.' This scale contains six items representing the definition they provide: 'the extent of encouragement and support for new ideas and innovative approaches.' Other researchers have taken similar approaches studying those climate factors that promote creativity (Isaksen et al. 2000, 1999; Burton et al. 1999; Ekvall and Ryhammar 1999; Ekvall 1996, 1987; Zammuto and Krakower 1991). Accordingly, a scale to assess the organization's climate for innovation is included.

Based on this theoretical background, the following hypotheses are proposed:

H1: Climate for innovation is positively associated with organizational commitment;

H2: Organizational commitment is positively associated with innovativeness; and

H3: Organizational commitment acts as a mediator between climate for innovation and innovativeness.

Construct Measurement and Questionnaire Development

Several scales have already been developed to measure organizational climate for creativity and are commercially available. Most of these scales, however, have been constructed to be used in R&D project settings having professionals in product development as respondents. Consequently, we opted to refine our own scales for each construct. Each scale was constructed drawing from past literature and especially tailored to the study's objectives and respondents. Regardless of the adjustments, we believe their use is not limited to this particular sector, and they can be utilized in any manufacturing industry.

Organizational commitment was assessed using Cook and Wall's (1980) scales for affective commitment. The reason for choosing these scales was the similarity with our target group and their positive psychometric properties. We chose to assess only affective commitment given our target group (mostly blue collar workers), assuming that continuance commitment was more significant among executives or professional staff. Accordingly, three dimensions were used: identification (adoption as one's own, the goals and values of the organization), involvement (psychological immersion or absorption in the activities of one's work role), and loyalty (a feeling of affection for and attachment to the organization) (Buchanan II 1974) (**Table 1**).

Table 1. Overview of construct measurement.[a]

Concept (*n* items)	Dimension	Concept description	Source
Innovativeness (12)	Products Processes Business systems	Mill/company propensity to adopt/create (dimension types)	Knowles et al. 2008
Organizational commitment (9)	Loyalty Identification Involvement	Feeling of belonging and attachment to the company	Cook and Wall 1980
Climate for innovation (24)	Team cohesion Supervisor encouragement Autonomy Challenge Openness to innovation Resources	Elements perceived by employees known to enhance creativity in the workplace	Amabile et al. 1996

[a] All scales used a Likert-type seven item scale with agreement levels as end anchors.

Climate for innovation was operationalized following Amabile's (1996) componential model of creativity and innovation in organizations. After a comprehensive literature review, six dimensions were selected: team cohesion, supervisor encouragement, autonomy, challenge, openness to innovation, and resources.

Innovativeness was self-assessed by respondents using a scale under development at the time. This scale considered innovativeness as the propensity to create and/or adopt new products, processes, or business systems (Knowles et al. 2008). This instrument was developed on a broad U.S. sample of sawmill managers and followed a two-step approach to scale development (Anderson and Gerbing 1988).

The questionnaire was pretested on a sample of 22 U.S. managers from the forest products industry while they were attending a workshop at a Northwestern university. These results were satisfactory, and no major changes were introduced as a result of the pretest.

Data and Analysis

Below the methods employed in this study are described. A questionnaire was used for data collection in three companies.

Sampling

Data was collected in three forest products companies in the state of Oregon, selected with the help of experts in the industry who were fully aware of the purpose of the study. The objective was to select companies from both the primary and secondary sectors with a wide portfolio of products. Buy-in from managemenent was also a key factor. Company A is a primary manufacturer, while companies B and C are secondary manufacturers. Companies A and C are single-site operations, while company B corresponds to one production facility operated by a larger corporation. Company C is the most value-added oriented of the three, with high end products targeted at niche markets.

Both management (plant managers and supervisors) and hourly employees provided responses. Completed questionnaires were received from 198 employees,[2] with approximate within-company response rates of 20 percent, 40 percent, and 70 percent, respectively. Management from company C gathered all of the employees together, and they filled out the questionnaire during a pizza lunch. Respondents from companies A and B filled out their questionnaires at their own convenience.

(2) 28 managers, 170 hourly employees.

Survey Implementation

Questionnaires were distributed in each of the three mills to all hourly employees, supervisors, and upper management. The process started with a kick-off meeting between the principal investigator and a key top manager. At that meeting, the principal investigator explained the objectives and mechanics of the study and discussed alternatives for its administration, sample sizes, and logistics. That manager acted as project champion and explained the study to all potential respondents and coordinated the administration and collection of the questionnaires. Participation was voluntary but encouraged via the endorsement of the study by upper management.

Analysis

Software, tests, missing data

Statistical analysis was performed using SPSS 14.0 (basic statistical analysis) and LISREL 8.52 (factorial analysis). Structural equation modeling (SEM) was performed using the maximum likelihood (ML) algorithm. In order to refine the scales, several criteria were used: regression weights, fit indices, intercorrelation among factors, residuals values, and distribution and proportion of variance explained. Unidimensionality and internal consistency was assessed by calculation of composite reliability (similar to Cronbach’s alpha).

All of the missing data were regarded as missing at random, since the percentage missing for each question was less than 5 percent with no apparent pattern. The expectation-maximization (EM) algorithm for multiple imputation in LISREL was used to account for missing data. This was done using all of the available data within scales. Parameters and covariance matrices were examined before and after imputing. The imputation resulted in minimal changes, resulting in a final dataset consisting of 198 responses (one response was deleted due to an extremely high proportion of missing answers). No particularly ‘unfriendly’ items were found (Graham et al. 1996).

Sample size and the nature of the sample limit the scope of the conclusions that can be drawn from the study. Consequently, we attempted to assess the model, although some results are offered as a sample of the kind of outputs one can obtain from the proposed instrument. For example, when assessing a scale it is important to assess its discriminant validity. In this case, we looked at its ability to discover meaningful variation among companies. Sample size also prevents the performance of factor analyses for different categories of employees (e.g., management vs. hourly employees). Since no proper testing can be done on such a sample (e.g., factor invariance [Woehr et al. 2005]), it was assumed that the covariances observed were homogeneous across the different categories and hence the data was pooled for analysis (Patterson et al. 2005). To determine whether there were differences due to company membership, the intraclass coefficient (ICC) for each variable in the model were calculated. They were all below 0.11, suggesting a low membership effect.[3] Accordingly, all observations were pooled.

(3) Factor invariance was also tested for all factor betas and the indirect effect, finding no differences across companies.

Measurement Models

In the case of climate for innovation, based on Amabile et al.'s (1996) work, we hypothesized the existence of a six-factor, first-order construct: *supervisor encouragement, team cohesion, autonomy, resources, challenge,* and *openness to innovation*. Each factor had four items, with each of them loading onto a single factor (**Tables A1 and A2** in the Appendix).

In the case of organizational commitment, based on Cook and Wall (1980), we hypothesized a three -factor, first-order construct (*loyalty*, *identification*, and *involvement*). Each factor had three items, with each of them loading onto a single factor (**Tables A3 and A4** in the Appendix).

Results and Discussion

Climate for Innovation

Initially, a six-factor, first-order model was tested. The model showed acceptable fit (**Table 2**). But, there were strong correlations among all of the latent factors. Team cohesion and supervisor encouragement exhibited a correlation above 0.90. The same was true for team cohesion and challenge. This is not desirable as it may indicate collinearity[4] and lead to unreliable estimates (especially when estimating using maximum likelihood). This fact, in addition to the low reliability coefficients (five dimensions below the 0.7 cutoff point[5]) and the low amount of variance extracted (only two dimensions with values equal to or greater than the 0.5 cutoff point), suggested a different structure (**Table 3**). Consequently, the next step was to assess a one-factor construct with composite indicators (items). *Resources* was the weakest indicator of climate for innovation, nonetheless, it was highly significant. It is arguable, however, that low resources may also promote innovativeness in the workplace, suggesting a U-shaped curve for the relationship between innovativeness and availability of resources.

(4) Issue also reported by Amabile (1997).

(5) Hu and Bentler (1999).

Challenge was dropped due to its poor psychometric properties[6] (composite reliability [CR] and variance extracted [VE]). This model showed excellent fit and adequate construct validity, measured in terms of CR (0.85) and VE (0.52) (**Table 2**). The t-values for the factor loadings were all significant ($p < 0.01$), with values between 9.2 and 12.1 (**Tables A1 and A2** in the Appendix).

(6) One president and GM expressed his disagreement with including this dimension as, in his opinion, it is in the better interest of the company to make the tasks as simple as possible. This seems to support the idea that challenge may not be a valid dimension for a production setting.

Table 2. Correlation matrix, composite reliability, and explained variance for the original dimensions of the climate measure.

Dimension	Dimension					
	TC	SE	AU	CH	OI	RE
Team cohesion (TC)						
Supervisor encouragement (SE)	0.91					
Autonomy (AU)	0.77	0.80				
Challenge (CH)	0.78	0.91	0.67			
Openness to innovation (OI)	0.78	0.78	0.79	0.56		
Resources (RE)	0.73	0.67	0.60	0.54	0.64	
Composite reliability	0.66	0.62	0.74	0.44	0.64	0.68
Variance extracted	0.44	0.36	0.52	0.36	0.42	0.50

Table 3. Comparison of model fit and construct validity between the original and final versions of the climate measure.

Criterion	Original version (six dimensions)	Final version (one-dimensional)
Chi-square	548.0 (p = 0.0, df = 237)	5.23 (p = 0.52, df = 6)[a]
Rounded mean square error of approximation (RMSEA)	0.079 [0.070 to 0.088]	0.00 [0.00 to 0.085]
Incremental fit index (IFI) (Delta2)	0.91	0.99
Comparative fit index (CFI)	0.91	0.99
Nonnormed fit index (NNFI)	0.90	0.99
Composite reliability	0.44 to 0.74	0.85
Variance extracted	0.36 to 0.52	0.52
[a] Chi-square difference test ($p < 0.01$)		

Organizational Commitment

The three-factor, first-order initial model showed good fit (Chi-square$_{27}$ = 80.5, CFI = 0.95, RMSEA = 0.099, SRMR = 0.060, PNFI = 0.69). An evaluation of construct validity, however, revealed that only *identification* had values for CR and VE greater than the cutoff points.[7] Furthermore, an extremely high correlation between *identification* and *loyalty* was found (r = 0.98) showing lack of discriminant validity between the two factors. Based on previous studies (McMurray et al. 2004), a higher order construct with two lower order factors was assessed. As Byrne (2005) noted, "a higher order model can take into account the unique variance associated with each first-order factor that is not shared in common with each of the other first-order factors and partition this variance from measurement error variance." In this new model, *identification* and *loyalty* were merged to deal with the issue of discriminant validity identified previously. After deleting one item from involvement and one from loyalty, the model showed good fit (**Table 4**). Accordingly, items on the organizational commitment scale are better represented by a second-order structure such that (overall) organizational commitment "causes" the lower order factors of *loyalty* and *identity* and *involvement*, which, in turn "cause" the observed behavior tapped by the scales. The low disturbances (high R^2) for the lower order factors support the higher order structure of the construct. Construct validity was supported by the values for CR and VE although is likely that the inclusion of more items would improve the psychometrics of these scales.[8] VE, CR, and the actual loadings are shown in **Tables A3 and A4** in the Appendix).

(7) 0.7 and 0.5, respectively.

(8) Since covariances of the lower order factors cannot be estimated, we ran a first order model using the two new dimensions. This model showed good discriminant validity between the two dimensions.

Table 4. Comparison of model fit between the original and final versions of the Organizational Commitment measure.

Criterion	Original version (three dimensions)	Final version (second order, two dimensions)
Chi-square	80.5 (p = 0.0, df=27)	21.5 (p = 0.0, df=13)[a]
RMSEA	0.099 [0.074 to 0.120]	0.058 [0.00 to 0.10]
IFI (Delta2)	0.95	0.98
CFI	0.95	0.98
NNFI	0.93	0.97
PNFI	0.69	0.60
SRMR	0.060	0.036
[a] Chi-square difference test ($p < 0.01$)		

Innovativeness

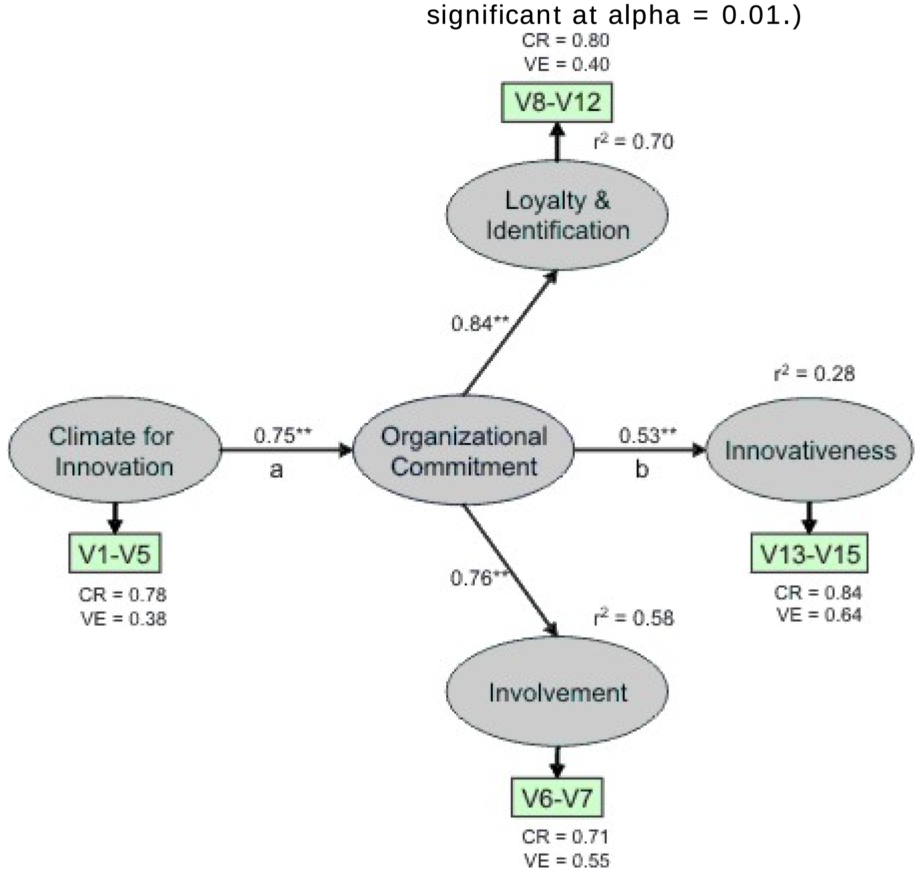
This construct showed good CR and VE (0.84 and 0.64, respectively). All of the loadings were highly significant ($p < 0.01$). Inter-item correlation varied between 0.72 and 0.88 (**Tables A7 and A8** in the Appendix).

Testing the Structural Model

Structural equation modeling allows analyzing complex models with latent variables. Such an analysis yields correlations and regression coefficients among the latent constructs. This statistical tool allows adjusting for measurement error while looking at the entire model. A structural model including all of the above assessed constructs was run to study the suitability of the model to depict the relationship among the constructs. To assess the suitability of a model with a mediator effect, Baron and Kenny's (1986) approach was followed to examine the mediation role of organizational commitment. It was found that the direct effect of climate for innovation on innovativeness significantly decreased when controlling for organizational commitment, suggesting mediation of the relationship by organizational commitment. Consequently, the structural model included organizational commitment as a mediating variable between climate for innovation and innovativeness. It is, therefore, suggested that climate for innovation affects how employees perceive the degree of their employer's innovativeness via its effect on their commitment to the organization. This model showed acceptable fit (Chi-square$_{87}$ = 163.3 (p = 0.0), CFI = IFI = 0.94, RMSEA = 0.068 [0.051 to 0.083], SRMR = 0.088). Standardized residuals were smallest and distributed normally around zero. All three constructs were positively associated, supporting hypotheses one and two. Twenty-eight percent of variation in innovativeness was explained by the factors in the model. To test for the significance of the indirect effect (climate for innovation over innovativeness via organizational commitment), the bootstrapping method advocated by Shrout and Bolger (2002) was followed. We based this choice on sample size and evidence of non-normality (kurtosis) for the standard error of the indirect effects. These issues may result in a loss in power to detect mediation. One-thousand bootstrap or pseudo samples of size 190 were created.[9] Then, empirical indirect effect means and standard errors for the indirect effect were estimated. The results indicated that the indirect effect was significant (b = 0.48 (99% CI: 0.15; 0.80), ß = 0.75 × 0.53 = 0.40) (**Fig. 2**). This finding supports hypothesis three.

(9) 991 iterations converged, suggesting good model specification.

Figure 2. Revised structural model with standardized regression coefficients. (** denotes regression coefficient significant at alpha = 0.01. Indirect effect (a × b) was significant at alpha = 0.01.)



A Brief Comparison Among Companies

Evidence[10] suggests that the scales properly discriminate among companies, especially for the case of climate for innovation. The primary manufacturer (company C) ranked lower in innovativeness but showed an above sample average for organizational commitment (**Fig. 2**). We believe this is explained by the existence of an upper management group highly committed to innovation (**Fig. 3**). When looking at climate for innovation, one can see that most dimensions showed levels above the midpoint of the scale (4.0). Exceptions to this are the degree of autonomy (companies A and B) and openness to innovation (company A) (**Fig. 4**). Management showed significantly higher levels than hourly employees for organizational commitment (**Fig. 3**).

(10) Analysis of variance.

Figure 3. Mean values for climate dimensions by company and construct. (Differences at $p < 0.05$ are labeled.)

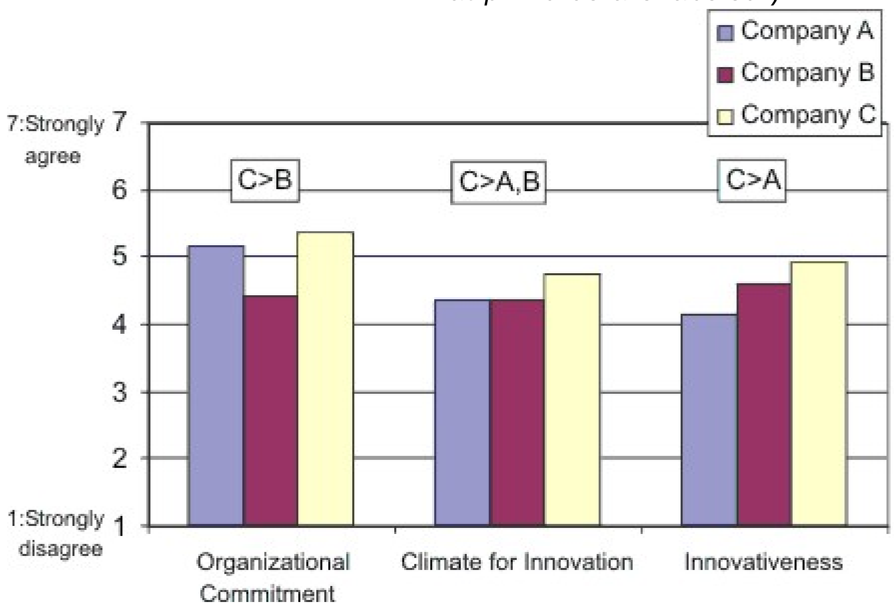


Figure 4. Average results by construct and type of respondent. (** denotes significant t-test ($p < 0.01$).

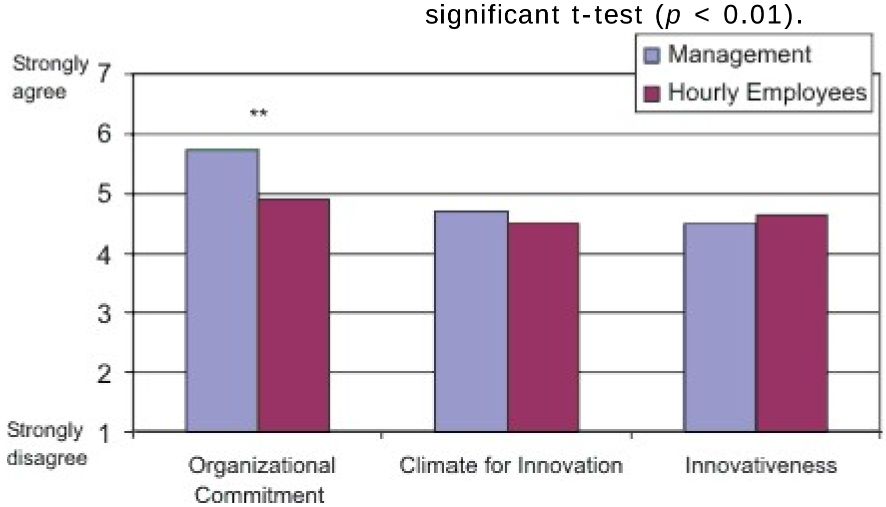
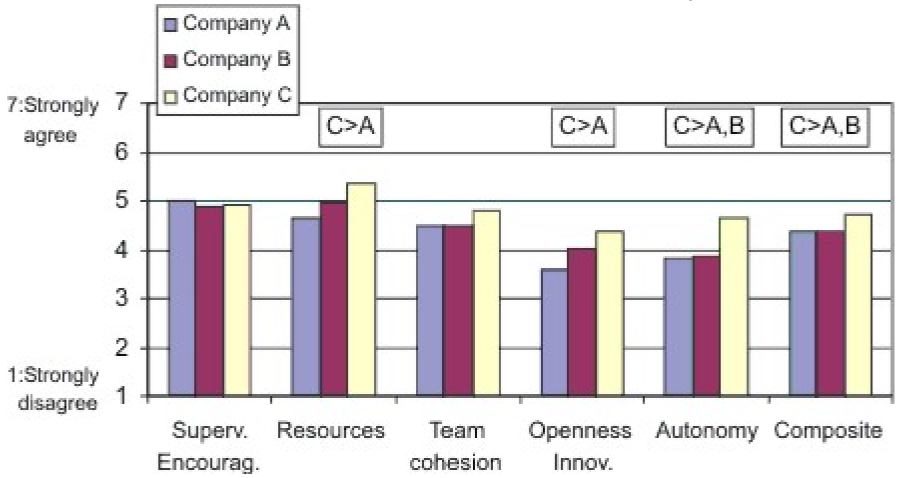


Figure 5. Mean values for climate dimensions by company. (Differences at $p < 0.05$ are labeled.)



Conclusions and Implications

The proposed hypothetical model was supported by the data. This model considers organizational commitment as a mediator variable between climate for innovation and innovativeness. This is important because it places innovativeness as an organizational feature that can be affected by managerial practices, resulting in a pro-innovation work climate and organizational commitment. This work climate is characterized by high levels of autonomy, cohesion, support, openness to new ideas and risk and resources and is expected to affect the degree of openness to change of a firm (innovativeness). This study proposes a theoretical framework to explain the antecedents of innovativeness that helps to fill a gap in past research. The proposed model integrates and extends past research and finds positive relationships among climate for innovation, organizational commitment, and innovativeness. The positive association observed between climate for innovation and organizational commitment suggests that a workplace that fosters innovation also results in a more committed workforce, characterized by high levels of identification, loyalty, and involvement. This study was exploratory in nature and the sample size small, so results must be interpreted conservatively. Further research may expand the model as to incorporate firm performance. These findings may help managers implement practices and policies aimed at enhancing the work climate dimensions found to be relevant in this study. Similarly, the findings suggest that employees who feel aligned, loyal, and involved with their companies perceive their employers as more innovative, and it is expected that this favorable perception will translate into more innovative behaviors. Managers have many tools available to develop and enhance organizational commitment and hence, indirectly promote innovation in an industry where it is badly needed.

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Appendix – Scale details (Final versions)

Climate for Innovation

The Climate for Innovation Measure consisted of a unidimensional construct with five indicators. Items marked with an asterisk (*) need to be reversed. The response scale was: 1 = Strongly disagree to 7 = Strongly agree. No anchors were given for other scale points (**Tables A1, A2, and A3**).

Table A1. The Climate for Innovation measure. Loadings, reliability, and validity.

Indicator	Standardized coefficient	Error	t-value	CR	VE
Team cohesion	0.81	0.35	--	0.85	0.52
Supervisor encouragement	0.74	0.45	12.1		
Resources	0.61	0.63	9.2		
Autonomy	0.71	0.50	11.3		
Openness to innovation	0.74	0.46	11.9		

Table A2. Means, standard deviations, and intercorrelations for the Climate for Innovation m (all items).

	Challenge				Autonomy				Supervisor encouragement				Resources				Team cohesion				Openn innov	
	ch1	ch2	ch3	ch4	au1	au2	au3	au4	se1	se2	se3	se4	re1	re2	re3	re4	tc1	tc2	tc3	tc4	oi1	oi2
ch1		0.29	0.26	0.24	0.35	0.12	0.00	0.29	0.18	0.42	0.15	0.20	0.02	0.19	0.16	–0.02	0.28	0.33	0.16	0.15	0.23	0.13
ch2		1	0.31	–0.01	0.35	0.39	0.19	0.26	0.14	0.33	0.47	0.43	0.28	0.27	0.32	0.03	0.41	0.34	0.27	0.08	0.27	0.31
ch3			1	0.05	0.15	0.22	0.04	0.24	–0.06	0.20	0.24	0.24	0.11	0.16	0.17	–0.03	0.28	0.18	0.24	0.13	0.30	0.17
ch4				1	–0.04	–0.10	–0.01	0.03	–0.04	–0.04	–0.14	0.03	–0.19	–0.31	–0.16	–0.28	–0.10	0.09	–0.13	–0.03	–0.16	–0.02
au1					1	0.53	0.27	0.50	0.26	0.43	0.41	0.36	0.29	0.32	0.39	0.13	0.34	0.32	0.38	0.31	0.19	0.36
au2						1	0.36	0.55	0.16	0.26	0.33	0.38	0.29	0.30	0.34	–0.03	0.32	0.27	0.40	0.36	0.30	0.55
au3							1	0.22	–0.01	0.08	0.19	0.15	0.20	–0.50	–0.06	–0.05	–0.02	0.09	0.09	0.01	0.06	0.16
au4								1	0.18	0.38	0.39	0.42	0.39	0.27	0.28	0.13	0.26	0.39	0.32	0.39	0.29	0.44
se1									1	0.23	0.09	0.25	0.13	0.19	0.15	0.19	0.09	0.18	0.14	0.06	0.03	0.09
se2										1	0.31	0.43	0.23	0.26	0.29	0.04	0.27	0.39	0.38	0.24	0.30	0.36
se3											1	0.38	0.33	0.34	0.36	0.09	0.22	0.24	0.23	0.20	0.31	0.34

se4												1	0.41	0.21	0.23	0.02	0.43	0.47	0.46	0.15	0.25	0.42
re1													1	0.37	0.36	0.16	0.40	0.21	0.37	0.18	0.29	0.38
re2														1	0.49	0.35	0.29	0.14	0.32	0.25	0.34	0.35
re3															1	0.34	0.31	0.22	0.36	0.26	0.28	0.33
re4																1	0.09	0.12	0.15	0.24	0.10	0.01
tc1																	1	0.35	0.43	0.22	0.38	0.29
tc2																		1				