

# GROUPWARE USES AND INFLUENCE ON PERFORMANCE IN SMEs

ANGEL L. MEROÑO-CERDÁN

Universidad de Murcia  
Murcia, Spain

## ABSTRACT

According to literature a research model of SMEs uses of groupware and its influence on performance is proposed. The model incorporates concepts from the TOE framework and Information Technologies' relative advantage and perceived usefulness. From the analysis of data from a sample of 151 SMEs belonging to the computer industry, the main contribution of this work is confirmed: mere groupware adoption do not directly influence organizational performance. Only when groupware benefits related to participation are perceived and in certain contexts, groupware positively affects SMEs performance. Specifically, in those environments given to experimentation and tacit knowledge exchange, the use of participation-oriented groupware contributes to the improvement of organizational performance.

**Keywords:** Groupware, perceived benefits, performance, SME, TOE framework

## INTRODUCTION

Information technologies (hereafter IT) allow firms to obtain, process, store and exchange information. The benefits of IT are clear in well-structured work environments. If work flows, including people, tasks and tools, can be predefined, automation via IT may be the best option. According to Fielder, Grover and Teng (1), the conservative approach to IT implementation has involved the automation of existing processes within the limits of traditional functional structures based on the supposition of satisfactory processes designs.

To a large extent, group support technologies mean a rupture with these approaches. In association with knowledge management contexts, the role of information technology is to extend human capacity of knowledge creation through the facilities of speed, memory extension and communication. Therefore, the benefits of groupware are not as easily predetermined as in the case of traditional technologies. Technology does not guarantee the existence of the appropriate climate nor the processes for sharing information or knowledge (2). In fact, there are enough evidences of failed investments in collaborative technologies or knowledge management systems (3, 4).

Considering these arguments, it is reasonable to characterize investments in groupware as one of the most complex innovations in information systems especially in SMEs. In the literature about adoption of technological innovations, a research line trying to identify the firm's context affecting the processes of innovation adoption and implementation is found. It is the TOE framework, which pays special attention to technological (T), organizational (O) and environmental (E) contexts.

In order to mitigate the scarce research about innovation

adoption in SMEs (5, 6), this work focuses on studying the influence of groupware technologies on firm performance. Moreover, instead of analyzing the direct influence, the benefits obtained from groupware use are used as an intermediate variable. Therefore, not only the groupware adoption, but also the groupware adoption level and its influence on performance are considered. First, the work presents a literature review about technological innovations in SMEs related to groupware and benefits obtained from groupware. Then, a research model including the relationships between groupware technologies, groupware perceived benefits and organizational performance is proposed. Following this, the next section justifies the research method employed and, subsequently, the results from data analysis are shown. Finally, the results are discussed and the conclusions of the study are presented.

## LITERATURE REVIEW

### Innovations in information technologies in SMEs

An innovation is any idea, practice or object which is perceived as new by the adopter. The literature about innovation examines those factors affecting innovation adoption, the characteristics of innovation adopters and the adoption process and its diffusion (7). Tornatzky and Fleischer (8) developed the TOE framework which identified three aspects of the firm's context that affect the process by which technological innovations are adopted and implemented: technological, organizational and environmental contexts. One of the most prominent authors in the study of innovation is Rogers (9) who identifies the groups of adoption predictors. The first one refers to the leader's characteristics and his or her attitude towards change. The second focuses on internal characteristics of the organization, especially, those aspects related to organizational design. The third includes external business characteristics such as system openness. He also stressed the impact of technological characteristics on potential adopters. Since the leader's characteristics can be viewed as specific internal organization properties, Rogers' analysis is consistent with the TOE framework. Furthermore, the distinction of leader's characteristics makes this analysis particularly appropriate for SMEs.

Zhu, Kraemer and Xu (10) found empirical support for the TOE framework in the field of information systems. One of the most outstanding works is Thong's (6), which focused on the adoption of information systems in SMEs by analyzing barriers to IT adoption. Since SMEs are quite centralized organizations depend largely on their CEO's characteristics, who usually is not too aware of IT benefits. Another defining feature is the high risk linked to their projects of investment in information systems. Their limited financial resources and their dependence on the short term, turn SMEs in firms

**Table 1. Classification of groupware Electronic Communications Systems Teamwork Systems**

Concept	It allows the exchange of information, documents and opinions.	Work is done through the system
Aim	Relation	Integration
Applications	Email, discussion forums, repositories, yellow pages	Workflow, project management, shared databases, group decision systems

very sensitive to success of investment projects, basically because they do not have enough resources for facing up possible failures. Therefore, they tend to adopt low-cost information systems.

The few works that use the TOE framework for studying innovation in information systems asked for the extension of the model to other domains of innovation (11). This work focuses on the analysis of the level of use and the benefits obtained from groupware in SMEs. Therefore, it can contribute to the development of knowledge within this field.

### Groupware

Groupware supporting and harnessing group working is responsible, to a large extent, for the increasing importance of knowledge management. Collaborative technologies play a key role in knowledge management programs (12, 13, 14), although other technologies borrowed from different disciplines are also employed (15).

From the proposals of Nunamaker, Briggs, Mittleman, Vogel and Balthazard (16), DeSanctis and Gallupe (17) and Pinsonneault and Kraemer (18), Table 1 shows a classification of groupware technologies including two categories: systems oriented towards making information exchange easier, or "electronic communication systems", and systems that support the work of teams or "teamwork systems". The aim of the first ones is to make the relationship between individuals or institutions easier, for instance, among employees or with clients. The second ones aim to integrate information in work processes that have been previously defined, like automated work flows.

The main difference between both categories is the versatility of Electronic Communication Systems (ECS). Since they affect the communication processes, their success depend to a large extent on the interest of users in sharing their information or knowledge and on the level of exploitation of the possibilities offered by these technologies. The flexibility of groupware, especially of ECS, favours that the group ultimately defines its use. For this reason, it can be found ECS uses exclusively related to information exchange but also uses oriented towards supporting group working in processes and joint decision-making. Therefore, certain permeability in the implementation of these systems occurs. An explanation to this phenomenon can be found in the structural model of technology. Against the technological imperative, involving foreseeable behaviours and results arisen from technology, emerges the structural model of technology (19) where technology is socially built by actors through the different meanings they give to it and of the varied characteristics they emphasize and use. However, once it has been developed and deployed, technology tends to become institutionalized and to lose its connection to the human agents that built or gave it the meaning and it appears as part of the objective and structural properties of the organization.

### Benefits of groupware and influence on performance

The role of benefits obtained from groupware use and their influence on performance can be analyzed in accordance to two perspectives. The first one is the relative advantage within the "theory of innovation diffusion" defined as the degree to which an innovation is perceived to be better than its precursor (20). The second perspective is the perceived usefulness within the "technology acceptance model", defined as the degree to which an individual believes that he or she can improve his or her performance by using a certain system (21). Among the empirical studies analyzing the relative advantage of IT in innovation is Lee's work (22), who considered its significant role in the adoption of the following technologies: e-mail, web site and electronic sales. Thong (6) found that the relative advantage is a determining factor in the adoption, but not in the extension of the adoption.

Even when the potential benefits of groupware seems clear under the perceived usefulness and the relative advantage perspectives, contradictory results are found in practice as stated in the introduction. The so-called productivity paradox of IT is more pronounced regarding these technologies. Johannesen, Olaisen and Olsen (23) believe that the causes of the productivity paradox are different to those proposed by Brynjolfsson (24). The real problem is the lack of understanding of tacit knowledge and its relationship with IT. Therefore, it must be expected that investments in traditional IT have limited consequences on competitiveness and, therefore, on organizational performance. Tacit knowledge represents the most valuable resource for knowledge management, especially in innovation processes (25). The literature about knowledge management focuses on the coding of existing knowledge in explicit forms and sharing this knowledge through the whole organization using IT tools (26, 27). However, tacit knowledge is not easily formulated or transferred into explicit forms because it is personal and contextual. The communication of tacit knowledge needs a shared system of meaning for its understanding and application (28).

### RESEARCH MODEL

The research model includes two aspects that are interconnected by the role played by groupware perceived benefits. First, it analyses the link between groupware technologies and their perceived benefits and, second, the influence of groupware perceived benefits on organizational performance is examined. Consistent with the TOE framework, certain organizational characteristics which may influence the analysis, as it will be later justified, are introduced in both relationships. Figure 1 shows, in an integrated manner, the above mentioned relationships. In the first one, groupware perceived benefits are the dependent variable, while in the second, they are introduced as independent variable.

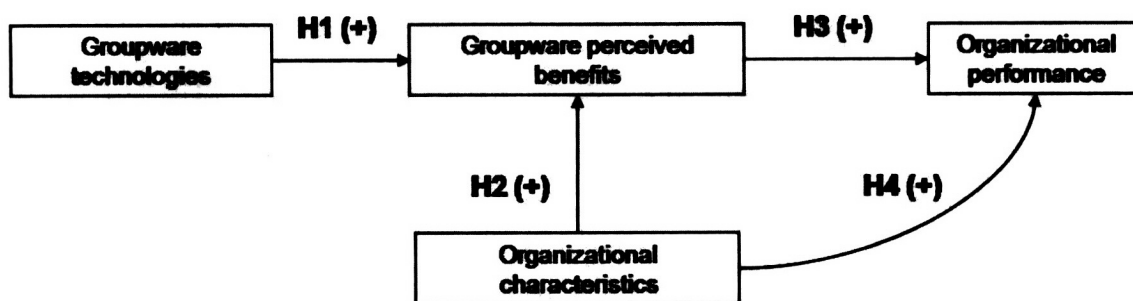


Figure 1. Research model

### Influence of groupware technologies and organizational characteristics on groupware perceived benefits

From the proposed classification of groupware, it is expected that groupware oriented towards work execution (teamwork systems) emphasizes task execution in a more productive way and, therefore, it is believed to have a positive effect on efficiency, while those technologies related to information or knowledge exchange (electronic communication systems) are expected to be oriented to a larger extent towards collaboration and participation. That is, the benefits obtained from groupware use will depend on the level of technology equipment.

**Hypothesis 1.** *The type of groupware employed determines groupware perceived benefits.*

Certain organizational characteristics related to innovation and collaboration are expected to influence groupware perceived benefits. First, the influence of the CEO will be analyzed since this is a key figure in SMEs innovation. The CEO's attitude towards innovation has found empirical support as a predictor of the adoption of collaborative technologies (29, 22, 6). Therefore, an innovative CEO should positively influence the obtaining of benefits from groupware.

The existence of organizational practices oriented towards information and knowledge externalization should be positively related to the obtaining of benefits from groupware use. That is, the existence of a favourable environment for knowledge management must strengthen the groupware perceived benefits and it is, in some way, a predictor of its success. In this sense, Park, Ribière and Schulte (30) suggested that an adequate organizational culture can help to a successful implementation of knowledge management.

The outcomes derived from groupware, especially "Electronic Communication Systems" should depend on its use. Technology is socially built by actors through the different meanings they give to it and of the varied characteristics they emphasize and use (19). Therefore, organizational contexts favouring employees' participation and creativity can find groupware as the ideal vehicle to channel the potential of participants, allowing them to share and develop their individual knowledge. Autonomy is viewed as a significant dimension of learning climates that facilitate learning among individuals or groups of individuals (31).

**Hypothesis 2.** *The organizational context influences groupware perceived benefits. The variables considered are CEO's innovativeness, knowledge externalization and employees' autonomy.*

### Influence of groupware perceived benefits and organizational characteristics on organizational performance

The productivity paradox referred to investments in IT is especially relevant in the case of groupware. Although information technologies are an important reason for the emergence of knowledge management, it is not easy to find evidences of the profitability of IT investments in knowledge management contexts. Lee and Choi (32) found a relationship between the use of IT and knowledge creation processes based on the combination of explicit knowledge. However, no relationship was found with processes based on socialization, internalization and externalization. Regarding the influence of knowledge management on performance, Gold et al. (31) found that efficient knowledge management contributes to key aspects of organizational performance. Choi and Lee (33) also found a positive relationship between knowledge management and outcomes.

In short, the influence of IT related to knowledge management on performance cannot be easily demonstrated. The simple adoption of groupware does not guarantee the effect on performance, especially when considering the versatility of Electronic Communication Systems. The explanation to this phenomenon can be found in the fact that SMEs can adopt low-cost and low sophisticated technologies with no intention of changing the way they work. For instance, they can adopt document repositories which are just document warehouses without associated search technologies. This could be also the case of discussion forums hosted by a third party in the Internet with no costs for the firm. Therefore, the fact of having groupware does not say anything about the use or about the effect on outcomes. Perceived benefits from groupware use should be an estimate of groupware uses influence on organizational performance. These considerations lead to the formulation of the following hypothesis.

**Hypothesis 3.** *Groupware perceived benefits have a positive influence on organizational performance. Nonetheless, the simple adoption of groupware is not related to organizational performance.*

Consistent with the TOE framework and due to the relationship with knowledge management, other variables that explain the organizational performance will be introduced. The influence of CEO's innovativeness will be considered because it is a significant factor within SMEs. The level of knowledge externalization within the organization will be included because it should reflect organizational concern in knowledge sharing. Finally, the employees' autonomy is also included as far as



organizational design allows employees to experiment with their knowledge thus improving organizational knowledge assets.

**Hypothesis 4.** *Organizational characteristics related to CEO's innovativeness, knowledge externalization and employees' autonomy positively affect organizational performance.*

## METHOD

### Sample and data collection

The units of analysis in this study are firms belonging to the computer industry in the Region of Murcia (Spain). Only firms with at least two employees have been selected. The population was 253 firms and 151 valid responses were obtained, that is, a response rate of 59.9%. The error is 5.1% for  $p=q=50$  and a confidence level of 95.5%. Information gathering was based on personal interviews with the key informant, in this case, the manager, who has privileged information about the firm. A structured questionnaire was used. Data from interviews were collected in 2002.

Table 2 shows the profile of respondents. They are clearly SMEs with an average number of employees of 12.8. The distribution among firms devoted to software (45.7%) and hardware (54.3%) is balanced. The dynamism of the industry in terms of age of the firm must be also highlighted. On average, firms have 7.5 years of existence; two thirds have less than 9 years.

**Table 2. Sample description**

Variable	%
<i>Size</i>	
Micro	72.2
Small	24.5
Medium	3.3
<i>Industry</i>	
Hardware	54.3
Software	45.7
<i>Age</i>	
Less than 4 years	33.3
Between 4 and 9 years	33.3
More than 9 years	33.3

### Development of instrument

*Groupware (GW).* Groupware technologies have been classified into Electronic Communication Systems and Teamwork Systems. In order to measure the presence of those systems a set of applications have been chosen as representatives of each category. Within the first, discussion forums and document repositories have been selected, since they are very frequently used as knowledge management tools. Regarding the Teamwork Systems, shared databases has been selected for the same reason. The concept of shared database can be quite broad but, in any case, it refers to the availability of a common electronic workplace where information can be looked up or introduced in a predetermined way. Binary variables have been used for knowing whether or not the firm has the different applications.

*Groupware perceived benefits.* Consistent with the approach of perceived benefits as a relative advantage, it should be analyzed if the use of groupware is an advantage in comparison to the work performed without these tools. The possibility of exchanging information without being physically together can imply a cost and time savings. At the same time, the facilities for distributing information can result in other advantages like a better knowledge of the firm by employees. In a more active orientation, to allow employees to provide information and knowledge can imply, on the one side, a closer relationship among colleagues and, on the other side, a higher participation in the firm. According to the terminology of the procedural justice (34), to facilitate the participation implies the consideration of the participants' ideas and, at a second level, the influence of their ideas.

Each item has been measured on a seven-point Likert-type scale. Table 12 (Annex) shows statistics and correlations for all of them. The existence of high correlations suggests the appropriateness of using data reduction techniques. Therefore, an exploratory factor analysis was carried out using the principal components analysis as extraction method and varimax normalization as rotation method. Two factors explaining 55.4% of the variance were extracted. The Kaiser-Meyer-Olkin measure of sampling adequacy reaches 0.68, over the 0.6 recommended by Hair, Anderson, Tathan and Black (35), and the Barlett's test of sphericity is significant. The first factor included the first three items (cost, time reduction and knowledge of the firm); while the rest (closer relationship, consideration of ideas and people's influence) were included in the second factor. The first factor was called "efficiency-oriented GW perceived benefits" (GW efficiency) while the second was named "participation-oriented GW perceived benefits" (GW participation) because it emphasizes the voluntary and unplanned information and knowledge exchange which, in principle, is more related to participation through collaboration and knowledge management than to the more efficient execution of the same tasks.

*Organizational Performance.* For measuring organizational performance, subjective measures have been used since they can be a reasonable substitute for the objective ones (36). The subjective measures have been used both for the case of SMEs (37, 38) and also within the field of information systems (39). The factors considered for determining SMEs success are: costs, market share, quality, use of technologies, employees' motivation and reputation. For each item, managers assessed its importance; the degree of achievement, and the final score was the product of both of them. Thus, the level of performance of each item is the result of multiplying the importance it has for the firm by its level of achievement. Table 13 (Annex) shows the descriptive statistics for all items. Bivariate correlations between variables representing organizational performance were all found significant ( $p < 0.01$ ).

*CEO's Innovativeness.* This attitude has been measured according to his or her capacity for managing the change. That is, his or her level of change acceptance and implementation in the organization, project initiation and innovations introduction and, finally, his or her risks acceptance. As in the previous variables, a seven-point Likert scale has been used. Table 14 (Annex) shows the descriptive statistics. Another exploratory factor analysis was performed with one factor explaining 64.7% of the variance. Kaiser-Meyer-Olkin was 0.62. Again, bivariate correlations between variables representing this construct were all found significant ( $p < 0.01$ ).

*Employees' Autonomy.* To allow employees to participate in the decision making process and to have control over their

**Table 3. Reliability and validity**

Measure	Items	Mean	SD	Reliability Cronbach's alpha	Convergent validity (item-to-total correlation)	Discriminant validity (factor loading on single factors)
GW efficiency	3	5.27	1.49	0.78	0.645; 0.618; 0.614	0.850; 0.832; 0.829
GW participation	3	3.55	1.84	0.76	0.478; 0.755; 0.554	0.740; 0.915; 0.808
Performance	6	34.13	7.82	0.83	0.530; 0.675; 0.670; 0.559; 0.570; 0.549	0.674; 0.789; 0.802; 0.705; 0.713; 0.705
CEO's innovativeness	3	5.99	1.09	0.72	0.637; 0.548; 0.422	0.875; 0.832; 0.696
Employees' autonomy	4	5.47	1.57	0.70	0.430; 0.527; 0.452; 0.487	0.674; 0.772; 0.710; 0.731

works has a positive effect on learning and the integration of new knowledge (40). Employees' autonomy is considered as the employees' participation in the definition of their positions, their attitude, capacity and possibility for providing creative solutions when facing unexpected events and their multipurpose qualification that allows the execution of other activities. Table 15 (Annex) shows the descriptive statistics. Here, an exploratory factor analysis was performed with one factor explaining 52.27% of the variance. Kaiser-Meyer-Olkin is 0.74. Bivariate correlations among items representing employees' autonomy were all found significant ( $p < 0.01$ ).

*Knowledge externalization.* In this case, the aim is to verify to which extent knowledge objects, electronic or not, include knowledge considered as useful for decision making. Here, the explicit knowledge objects considered are procedure manuals, databases and, generically, the intranet. Using a seven-point Likert scale, the mean for the sample and the standard deviation were 3.77 and 2.62, respectively. Thus, indicating high data dispersion.

### Reliability and validity

The validity of the construct is established by relating a measuring instrument to a general theoretical framework in order to determine whether the instrument is tied to the concepts and theoretical assumptions they are employing. In order to obtain evidence of construct validity, convergent validity and discriminant validity are assessed. For the first one, the item-to-total correlation is examined. The lower limit is 0.4. Discriminant validity is checked by a factor analysis. Each variable must have a factor loading in a single factor over 0.5. The results (Table 3) confirm that each construct is unidimensional and factorially different and that all items employed for operationalizing a particular construct load on a single factor. The reliability is the accuracy or precision of a measuring instrument, that is, the extent to which the respondent can answer the same or practically the same value each time. The internal reliability was assessed by calculating the Cronbach's alpha. It can be also observed that acceptable values are obtained in all cases.

## DATA ANALYSIS AND RESULTS

### Explanatory factors for benefits of groupware

Table 4 shows 70.9% of firms analyzed have some kind of group technology in their intranet. The most frequently found

technology are shared databases (98.1%), which are found in more than 70% of firms and, practically, in all firms that have any type of GW technology. The second technologies in importance are document repositories and, finally, discussion forums. Therefore, it can be deduced that the reason for implementing an intranet or local network is based on the possibility of getting access to shared databases. The second step may be fitting out a space for storing and retrieving documents. Discussion forums are present to a lesser extent.

**Table 4. Presence of groupware (GW)**

GW technology	% total	% firms with any GW technology
Shared databases	70.2%	98.1%
Repositories	45.0%	63.6%
Discussion forums	15.2%	21.5%

From these results, a classification of firms according to their level of technology equipment has been formulated (Table 5). When considering only those firms having some groupware, 33.7% only have shared databases, 48.5% have shared databases and repositories; and finally, 17.8% of firms having collaborative technologies have the three technologies at the same time and they show the highest level of equipment.

**Table 5. Levels of groupware equipment (GW)**

	Only firms with GW
Only databases (DB)	33.7%
DB + repositories (R)	48.5%
DB + R + Discussion forums (DF)	17.8%

In order to assess the influence of GW equipment on GW perceived benefits, a multivariate analysis of covariance (Mancova) was performed. The dependent variables were two possible benefits: efficiency and participation. The levels of groupware technologies acted as fixed factors. Also organizational characteristics were included as covariates for analyzing their influence on the dependent variables. The main advantage of the multivariate analysis in comparison to the variance analysis is that the first one measures simultaneously the influences on the dependent variables. The Wilks' Lambda statistic reached 0.84 and was significant ( $p < 0.01$ ) for groupware technologies. This means that there are differences in GW perceived benefits

**Table 6. MANCOVA: Tests of inter-subject effects.**

	Dependent variables	Sum of squares	df	Mean Square	F	Sig.
Corrected model	GW efficiency	24.77	5	4.95	2.58**	0.03
	GW participation	82.57	5	16.51	5.83***	0.00
Intercept	GW efficiency	34.10	1	34.10	17.75***	0.00
	GW participation	11.12	1	11.12	3.92**	0.05
Knowledge Externalization	GW efficiency	15.28	1	15.28	7.95***	0.01
	GW participation	9.96	1	9.96	3.52*	0.06
CEO's innovativeness	GW efficiency	2.95	1	2.95	1.54	0.22
	GW participation	3.79	1	3.79	1.34	0.25
Employees' Autonomy	GW efficiency	0.42	1	0.42	0.22	0.64
	GW participation	1.41	1	1.41	0.50	0.48
GW equipment	GW efficiency	0.77	2	0.39	0.20	0.82
	GW participation	49.81	2	24.91	8.79***	0.00

according to equipment level and, therefore, hypotheses 1 and 2 are confirmed.

Table 6 shows detailed information of the inter-subjects tests for all variables. The explanatory power on the two dependent variables was significant, both for the case of efficiency-oriented groupware ( $F=2.58$ ,  $p<0.05$ ) and for participation-oriented groupware ( $F=5.83$ ,  $p<0.01$ ). A R-squared of 0.121 was obtained in the case of those related to the benefits related to efficiency, and 0.237 in the case of those related to participation. Furthermore, the results indicated that there is a relationship between groupware equipment and GW perceived benefits (H1), Electronic Communication System increase GW benefits related to participation. Table 7 shows the results for each variable of GW perceived benefits and for each level of GW equipment. The results also suggested that the more complete the GW equipment is, the higher are the benefits related to participation, with significant differences between the three groups. That is, as firms incorporate electronic communication systems (documentation repositories and discussion forums), they obtain higher benefits related to participation. These differences were not found for GW efficiency benefits since all the GW equipment levels had the presence of shared databases. In fact, this circumstance evidences a relationship between Teamwork Systems and GW efficiency.

Regarding the organizational characteristics, it can be only confirmed that externalization is an explanatory factor, especially, for the benefits related to efficiency. Neither the CEO's innovativeness, nor the employees' autonomy influence the obtaining of benefits related to groupware use. Therefore, the more the firm becomes concerned with its knowledge externalization, the higher are the benefits obtained from groupware. The explanation lies in the fact that externalization takes place through the use of information technology.

#### Explanatory factors for organizational performance

In order to assess the influence of groupware use, and of the previously exposed organizational characteristics, on the organizational performance, linear regressions are used. The first regression (regression A) tests if firms equipped with groupware obtain better outcomes. In the second regression (regression B), the influence of GW perceived benefits on performance is analyzed.

**Table 7. GW perceived benefits according to the level of GW equipment**

	BD	BD + R	BD + R + DF
Efficiency	5.24	5.27	5.70
Participation	2.76	3.67	5.06

**Table 8. Results of regression on performance A**

	Model 1	Model 2	Model 3
<i>Control variables</i>			
Industry	-0.09	-0.13*	-0.13*
Size	0.07	0.10	0.10
<i>Independent variables</i>			
CEO's innovativeness		0.31***	0.31***
Groupware presence (GW)		-0.11	-0.10
Knowledge externalization (KE)		0.17**	0.18
Employees' autonomy		0.34***	0.34***
GW x KE			-0.02
<b>F</b>	0.797	12.533***	10.669***
<b>R<sup>2</sup></b>	0.011	0.345	0.345
<b>ΔR<sup>2</sup></b>		0.334***	0

$p<0.1^*$ ;  $p<0.05^{**}$ ;  $p<0.01^{***}$

Therefore, only cases of firms equipped with these technologies are considered. In both regressions, business industry and business size were used as control variables. Regarding business industry firms were divided into two categories, hardware and software, creating a dichotomous variable adopting value 1 for software firms and 0 for hardware ones. With regard to business size, in order to eliminate the influence of extreme values neperian logarithm of the number of employees is used.

Regarding the first regression on performance (regression A), where all firms are analyzed, a high explanatory power ( $R$  squared = 34.5%) was obtained as main result (Table 8). Once the low influence of control variables was isolated, the three organizational characteristics related to CEO's innovativeness, knowledge externalization and employees' autonomy, signifi-



cantly affected performance. However GW technologies presence did not significantly influence performance. Due to the apparent relationship between knowledge management and groupware, the interaction between the GW presence and knowledge externalization was introduced in model 3. However, it was not significant, that is, the contribution of the knowledge externalization to performance is not modified by the use of groupware. Therefore, it is confirmed that the simple adoption of groupware does not affect performance (H3).

Table 9 shows the results from just those cases of firms that have some kind of groupware. Model 2 introduces the independent variables and a significant adjustment (R-squared= 29.4%) is obtained. CEO's innovativeness and employees' autonomy coefficients are statistically significant, but this is not the case for knowledge externalization. None of the perceived benefits from the use of groupware have a significant effect on performance. That is, among those firms with groupware technology there are not differences in performance, not even when using GW use is considered useful. Due to the counterintuitive results, the interactions effects between knowledge externalization and GW perceived benefits were introduced in model 3. Only the interaction between knowledge externalization and benefits of participation-oriented groupware was considered to avoid multicollinearity problems. Model 3 shows a significant increase of the explanatory power with a R-squared of 37.6%. The combined effect of knowledge externalization and groupware benefits-derived from participation-on performance was found significant. Although the influence was negative. Moreover, when isolating the combined interaction effect, a significant direct positive effect on performance both of knowledge externalization and participation-oriented GW perceived benefits was obtained. Therefore, positive effects are expected when participation-oriented groupware is used associated to low levels of knowledge externalization and vice versa. Those firms worried about knowledge externalization obtain improvements in performance when they make a low use of participation-oriented groupware.

This unexpected relationship led us to examine the distribution of the variable knowledge externalization and it was found, apart from a high dispersion, a negative kurtosis (-1.8), meaning a high number of extreme cases. Most firms present low levels or high

**Table 9. Results of regression on performance B**

	Model 1	Model 2	Model 3
<i>Control variables</i>			
Industry	-0.12	-0.13	-0.16*
Size	0.18*	0.14	0.17*
<i>Independent variables</i>			
CEO's innovativeness		0.2**	0.14
Knowledge externalization (KE)		0.15	0.71***
Employees' autonomy		0.35***	0.39***
GW efficiency		0.12	0.11
GW participation (GW-P)		-0.04	0.40***
KE x GW-P			-0.83***
F	2.017	5.840***	7.253***
R <sup>2</sup>	0.038	0.294	0.374
ΔR <sup>2</sup>		0.257***	0.080***

P<0.1\*; p<0.05\*\*; p<0.01\*\*\*

levels but, in few occasions, they have medium levels. Consistent with this situation, in Table 10, the independent variables have been regressed on performance distinguishing two groups: firms with a high level of knowledge externalization and those with a low level. The grouping has been carried out using a cluster analysis. As commented previously there are some differences. The main one is the significant and positive contribution of GW participative uses on performance when the firm has low levels of knowledge externalization. In fact, when the levels are high, the contribution to performance of participation-oriented groupware is significant but negative. Another difference is that CEO's innovativeness only contributes to performance when the externalization levels are low.

In order to confirm these results, the Chow test (41) was performed. This test is used for finding significant differences in the estimate of coefficients when there are groups. In this case, the Chow test showed significant differences in performance for groups of low and high knowledge externalization in terms of GW participative uses (F(2,103)=8.16, p<0.01), CEO's level of innovativeness (F(2,103)=22.26, p<0.01) and employees' level of autonomy (F(2,103)=28.60, p<0.01). There were no differences in the case of efficiency-oriented GW (F(2,103)=1.88, p>0.10).

## DISCUSSION AND CONCLUSIONS

Table 11 shows the study's hypotheses and the results obtained from data analysis.

Figure 2 shows a graphic summary of the results obtained by developing the research model initially proposed. The continuous arrows show confirmed relationships, while discontinuous arrows show the negative influence of high levels of knowledge externalization on the explanatory variables for organizational performance.

One of the main conclusions is the validity of the concepts from innovation literature applied to SMEs. In order to assess groupware uses in SMEs and its influence on performance, this work proposes "GW perceived benefits" based on the mixing of concepts of relative advantages (20) and perceived usefulness (21). The TOE framework (8) is also used for justifying the influence of organizational context on groupware adoption.

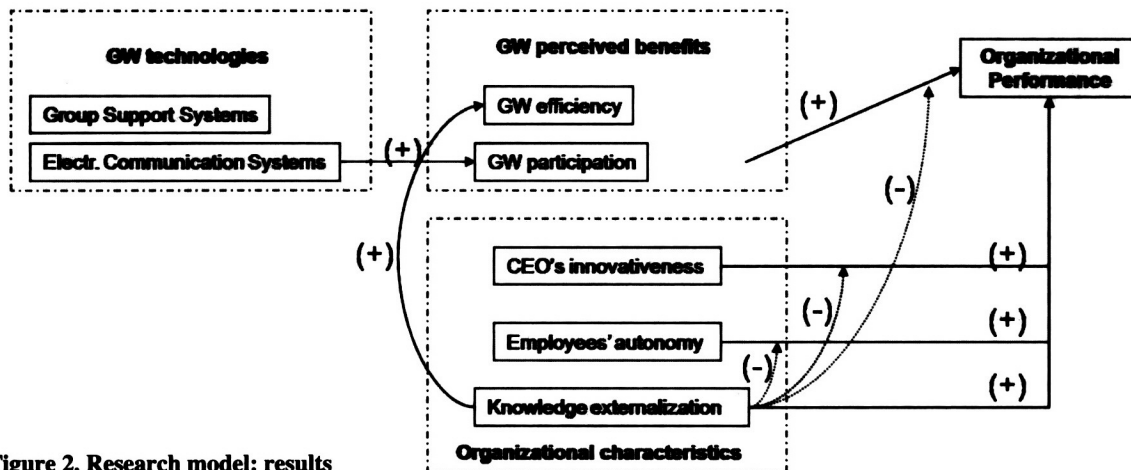
From data analysis, the main contribution of this work is confirmed: groupware can positively affect organizational performance in SMEs. This influence only takes place when benefits from uses related to participation are obtained. Thus,

**Table 10. Regression on performance B for externalization levels**

	High externalization	Low externalization
<i>Control variables</i>		
Industry	-0.17	-0.12
Size	0.09	0.26**
<i>Independent variables</i>		
CEO's innovativeness	0.06	0.21*
Employees' autonomy	0.45***	0.35***
GW efficiency	0.05	0.15
GW participation	-0.35***	0.26**
F	3.576***	5.497***
R <sup>2</sup>	0.328	0.412

**Table 11. Summary of hypotheses and results**

Hypothesis	Result
1. The type of groupware employed determines groupware perceived benefits	<i>Accepted</i> Electronic Communication Systems obtain higher values in GW perceived benefits related to participation and collaboration
2. The organizational context influences groupware perceived benefits. The variables considered are CEO's innovativeness, knowledge externalization and employees' autonomy.	<i>Partially Accepted</i> Knowledge externalization is the organizational characteristic more influent on GW perceived benefits
3. Groupware perceived benefits have a positive influence on organizational performance. Nonetheless, the simple adoption of groupware is not related to organizational performance.	<i>Accepted</i> Performance improves when using participation-oriented GW technologies associated to low levels of knowledge externalization
4. Organizational characteristics related to CEO's innovativeness, knowledge externalization and employees' autonomy positively affect organizational performance.	<i>Accepted</i> Organizational context influences on performance, acting knowledge externalization as a moderator variable



**Figure 2. Research model: results**

the simple adoption of groupware does not guarantee better performance.

Groupware, especially electronic communication systems, have some particularities which make them different from traditional IT. First, groupware technologies are low cost. Among the diversity of groupware there are low cost solutions and even free technologies (e-mail, repositories, etc.). Second, groupware technologies are complementary, groupware adoption usually is parallel to the normal work flows, performing a supportive role. These two characteristics make these technologies affordable for SMEs. Third, groupware technologies are versatile, users build technology through the meaning they give to it and the characteristics they emphasize and use (19). The affordability and versatility of groupware explain the inconsistency of results associated to these technologies.

Instead of the simple presence of groupware, profitability in terms of GW perceived benefits were considered. In this sense, two kinds of groupware use orientations were distinguished: uses related to participation and uses related to efficiency. The first ones refer to the presence of electronic communication systems and, precisely, this groupware is the one affecting organizational performance.

Regarding the role of organizational context variables and

benefits obtained from groupware, only knowledge externalization shows a significant influence, especially on efficiency-oriented groupware. However, neither CEO's innovativeness nor employees' autonomy result in higher perceived benefits from efficiency-oriented or participation-oriented groupware. Considering the influence of organizational context variables on performance, data have confirmed this relationship. In general, higher CEO's innovativeness, knowledge externalization and employees' autonomy positively affect organizational performance.

When analyzing the influence on performance only in firms with some kind of groupware, a key role of knowledge externalization, not expected previously, was found. The organizational context where positive effects from groupware can be obtained is related to low levels of knowledge externalization. The interpretation of these results slightly differs from our initial idea identifying knowledge externalization with a typical knowledge management environment. Probably, the participant SMEs and, especially, managers answering the survey, consider knowledge externalization from an operative way, that is, the distribution of information with little strategic value and not related to the most valuable knowledge, tacit knowledge. The highest influence on performance of CEO's innovativeness and



employees' autonomy when there is low externalization could support the previous statement. Then, low levels of knowledge externalization may refer to contexts given to experimentation where the use of participation-oriented groupware positively affects performance.

In order to offer practical recommendations, it can be concluded that groupware is affordable for SMEs, but to contribute to organizational performance certain adoption and implementation guidelines are needed. Beyond the supportive role of corporate information dissemination, groupware should allow the exchange and creation of tacit knowledge in an environment featured by innovation and autonomy.

This research shows that the role of knowledge externalization in SMEs needs further investigation. In terms of Hansen, Nohria and Tierney's (42) knowledge management strategies, knowledge externalization may fit with codification strategy and, in SMEs, it would be associated to control, hierarchy and, all in all, to environments not given to the exchange of tacit knowledge. This kind of organizational culture impedes groupware's contribution to performance even when GW benefits are perceived. It is only in those cases of low externalization characterized by the participation and influence of employees when improvements in performance can be obtained. This may be the case of a strategy based on personalization where the significant point is to achieve

that people show their experience, judgments, that is, the tacit knowledge with the highest value for the firm. In this type of environments, groupware technologies are expected to become ideal instruments.

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## ANNEX

**Table 12. GW perceived benefits: descriptive statistics and correlations**

(n=107)	Mean	SD	1	2	3	4	5	6
Cost reduction	4.81	1.96	1					
Time reduction	5.80	1.50	0.57***	1				
Knowledge of firm working	5.21	1.88	0.56***	0.52***	1			
Deeper employees' relationship	3.71	2.19	0.28***	0.17**	0.3***	1		
Employees' ideas consideration	3.37	2.24	0.08	0.01	0.19**	0.56***	1	
Employees' influence on decisions	3.57	2.29	0.24***	0.12	0.21**	0.31***	0.66***	1

\*\*\*p≤0.01; \*\*p≤0.05; \*p≤0.1

**Table 13. Organizational performance: descriptive statistics**

n=150	Importance (I)		Achievement (A)		Performance (I*A)	
	Mean	SD	Mean	SD	Mean	SD
Cost reduction	5.1	1.72	4.7	1.56	24.9	12.63
Market share	5.7	1.34	5.5	1.15	31.7	11.07
Quality improvements	6.3	1.00	5.9	0.97	37.7	9.57
New technologies	5.9	1.31	5.6	1.22	34.3	12.41
Employees' motivation	6.0	1.02	5.9	1.04	35.7	10.13
Reputation and prestige	6.6	0.87	6.1	0.86	40.5	8.37

**Table 14. CEO's innovativeness: descriptive statistics**

n=151	Mean	SD
Change introduction and acceptance	6.06	1.23
Project and innovations initiation	6.09	1.31
Risk acceptance	5.82	1.56

**Table 15. Employees' Autonomy: descriptive statistics**

n=151	Mean	SD
Workplace definition	5.64	1.52
Creative solutions when unexpected problems	5.80	1.32
Facing problems	5.88	1.25
Higher qualification polyvalence than required	4.56	2.20

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