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E-learning: organizational requirements for successful feedback learning

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Abstract

Purpose – Feedback learning transforms social knowledge into individual knowledge. In this process, tension arises because the current knowledge impedes the assimilation of new learning. Therefore, the feedback requires what Schumpeter refers to as "creative destruction": discarding, or at least setting aside, the institutional order to enact variations that allow intuitive insights and actions to surface and be pursued. This paper examines the relative importance and significance of "technological systems" on feedback and the effects on the creation of relational capital.

Design/methodology/approach – In this paper, the literature is reviewed to identify relevant measures and present a structural equation model, which is validated through an empirical investigation of 151 SMEs in the Spanish technological and information systems sector.

Findings – The results indicate that "the creative destruction" depends on the technology system of the company. Furthermore, if the creative destruction is a prior step in the feedback process, then the feedback process is influenced more by the creative destruction.

Practical implications – The results indicate that despite the majority of companies having connections to the internet, managers do not know the potential business benefits of technology systems for their clients, individuals and teams, and ignore the problem of human integration.

Originality/value – The findings are significant, since they introduce the traditional focus of a technology system at the feedback learning process.

Keywords Internet, Learning, Knowledge transfer, Feedback

Paper type Research paper

1. Introduction

Intellectual capital includes: human capital – the knowledge, skills, etc. of individuals; structural capital – knowledge that has been transformed into routines, structures or strategies; and relational capital – the relationships that an organisation has with its clients/customers and environment (Dewhurst and Cegarra, 2004). Organisational

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learning represents the mechanism by which the organization transforms the individual's knowledge into intellectual capital.

Crossan *et al.* (1999, p. 532) suggest that organisational learning is a dynamic two-fold process (feed-forward and feedback), which March (1991) also called "exploration" and "exploitation". Through the "feed-forward" process, new ideas and actions flow from the individual to the group at organisation levels. At the same time, what has already been learned "feedback" from the organisation to the group and individual levels, affects how people act and think. In this dynamic process, Crossan *et al.* (1999) assert that not only does learning occur over time and across levels, but it also creates a tension between assimilating new knowledge (feed-forward) and exploiting or using what has already been learned (feedback). In the feedback process tension arises because the current knowledge (i.e. what has already been learned) impedes the assimilation of new group and individual learning. Therefore, the "feedback" requires what Schumpeter (1949), refers to as "creative destruction": discarding, or at least setting aside, the institutional order to enact variations that allow intuitive insights and actions to surface and be pursued.

Igonor (2002) suggests that e-learning refers to learning that is delivered or enabled via electronic technology. It encompasses learning delivered via a range of technologies such as: the internet, electronic distribution technologies and basic PC technologies (PCT) (Moffett and McAdam, 2003). Previous works about the influence of technologies on small- to medium-sized enterprises (SMEs) (Harrison *et al.*, 1997; Lind *et al.*, 2000; Martin and Matlay, 2001; Benamati and Lederer, 2001) have considered the feed-forward and the feedback as parallel processes, they have not used their time to evaluate how the creative destruction has improved by using technological systems, or, which of these processes (i.e. feedback or the creative destruction) must be considered as a prior step in the creation of intellectual capital by technological systems.

We conducted an empirical investigation of 151 SMEs from the Spanish technology and information systems sector to examine the relative importance and significance of technology system on "learning" and their effects on the creation of intellectual capital. The Spanish technology and information systems industry is typical of SMEs, which constitute 99.8 per cent of businesses in Spain. Spanish technology and information systems offer client specific products and services and are subject to a highly dynamic environment subject to fierce competition (industry trends, customers, competitors, creation of new products and systems, e.g. operating systems, networking software applications) and rapid advances in technology (e.g. networking technology, information sources and navigation tools). Consequently, Spanish technology and information businesses are highly motivated to introduce processes to create relational capital and attempt to systematize the "learning" process (Osland and Yaprak, 1995). Data were collected via a personal survey carried out by the manager or general director of the SME with constructs based on the key factors identified below.

2. Feedback learning, creative destruction, and relational capital

Despite the apparent differences between these three concepts of organisational learning processes (i.e. feed-forward, feedback, and creative destruction), they all consider learning as a generic cycle which starts and ends with individual learning. Crossan *et al.* (1999) argue that organizational learning takes place at different levels (i.e. individual, group, and organisational), but still interact. The feed-forward

represents the "individual" and "group" levels. In this phase, the individual interpretations need to be integrated across individuals and groups within the organisation in order to become organisational, or at least shared by a group.

However, organisational learning is different from the simple sum of the learning of its members. Although individuals may come and go, what they have learned as individuals or in groups does not necessarily leave with them. Crossan *et al.* (1999) assert, that organizational learning is the process of "institutionalising", whereby learning becomes embedded in routines, structures and strategies. Only in this way, spontaneous feed-forward learning becomes less prevalent, as the prior learning, i.e. feedback becomes embedded in the organization and begins to guide the actions and learning of organizational members.

According to Carroll (1998), feedback supports learning because it reduces uncertainty. It tells employees about their learning – what is working (do more of this) and what is not (do less of this). Therefore, feedback helps learners adjust what they are doing so they are more successful. Carroll (1998) combines both the cognitive and action perspectives of learning. He identifies four processes of organizational learning that form a feedback cycle:

(1) "observing" (i.e. noticing, attending, heeding, tracking);

(2) "reflecting" (i.e. analysing, interpreting, diagnosing);

(3) "creating" (i.e. imagining, designing, planning, deciding); and

(4) "acting" (i.e. implementing, doing, testing), where acting affects observing, and so forth.

Carroll (1998) claims that feedback learning takes place through various kinds of work activities, e.g. meetings, peer visits and exchanges of best practices. According to Onge and Wallace (2003, p. 184), "meetings with customers should be a permanent channel for feedback" since they provide the organization with a clear reference to where the efforts must be aimed, and at the same time they achieve relevant information on the needs and desires of clients to interpret and consequently to act.

Makhija and Ganesh (1997) establish, that meetings are useful to transfer explicit knowledge, but they are insufficient to transfer tacit knowledge. They consider that informal activities are more useful (e.g. dinners, lunches, and travels). According to Dawson (2000, p. 130), informal mechanisms reinforce the beliefs and common values that interaction obtains tacit knowledge more easily when it is "informal" than when it is "formal". Furthermore, feedback must guarantee the absorption and knowledge utilization on the part of the individuals in particular, and then as a consequence of the organization. In this aim, Gulati (1995) suggests that time is required to adapt the client's knowledge, particularly tacit knowledge, to the operation of the organization. Day (2000, p. 61) affirms that "time is provided through a continued collaboration with the client".

Hedberg (1981) defines "creative destruction" as the process in which obsolete and misleading knowledge is rejected. Hedberg (1981) describes this process, as a series of "little deaths" at the micro-level, since old structures and ways of thinking must be removed from the repertoire in order to make room for new structures. Spender (1998) suggests that organizations cannot change and "unlearn" and that only individuals can do so. Jelinek (1979) draws attention to the fact that organizations cannot have

quasi-individual thought processes, and that only people are capable of learning and "unlearning" by means of mental activity. Consequently it is through individual "unlearning" that the members of an organization will allow "creative destruction" to occur and result in improved productivity (Hedberg, 1981).

Schein (1993) affirms that all forms of "unlearning" and change begin with some failures, which have been generated by aims that do not conform to individual and organizational expectations (e.g. falling turnover, rising costs, financial deficit, public criticism, or changes of leadership). These fuel unfreezing processes in which old ways of thinking and behaving are discarded and new ways can be accommodated. When an organization is faced with a problem it is said that it enters a situation of chaos, however, because of chaos, tension will increase and everyone will concentrate efforts toward the identification and resolution of the problem in the organization, and this often triggers new learning (Nonaka and Takeuchi, 1995).

According to Watzlawick *et al.* (1974) when a problem is discovered by an organisation, the "unlearning" process is going to change some individual cognitive patterns in order to solve the problem. The cognitive patterns may dissolve either when old problems or events are seen as having new outcomes, or when the event or problem itself is perceived differently as something new or changed. In the former situation, there is the perception that new information does not fit, so the connection between event and outcome is broken. In the latter case, it is this changed perception, which leads to a break in the connection between event and outcome, then the event or problem can be "restructured".

In order to change cognitive patterns, Fahey and Prusak (1998) and Von Krogh (1998) recognise mistakes as something natural and suggest that organisations should tolerate any resulting well-intentioned failure. Sitkin (1992) supports this view and suggests that a regular occurance of small failures promote necessary variety so that learning can occur. However, changes in individual and group behavior without a corresponding change in an organization cognition are transitional states since they create tension between an individual's beliefs and an organization's action. This tension can only be relieved by integrating changes in organizations with changes in individuals and groups so individual beliefs and organizational actions are in accordance with each other.

Edström (1988) suggests that the purpose of "learning and unlearning" will be different for everyone in the organization. From an employee's point of view, unlearning can be conceived as an investment (i.e. the time and effort to unlearn). But "unlearning" will be driven by institutional objectives (e.g. survival and growth) from the point of view of an organization. Therefore, it is necessary to extend the range of indicators and measures by identifying common measures for workers, teams and organizations, e.g. considering aspects such as the number of advances and faults communicate of one department to other departments rather than the number of faults generated (Kaplan and Norton, 2000).

On the other hand, Malhotra (2000) asserts that technologies deliver the right information to the right person at the right time. There is a significant amount of research in the area of technology systems classification, development, and implementation. In this work, following suggestions from Moffett and McAdam (2003), technologies have been classified in three dimensions:

(1) "Internet technology" (IT) enables customers and employees to have instantly available information about products and services across time zones and distance (Tetteh and Burn, 2001; Porter, 2001). This promotes a greater learning and understanding of both internal and external issues (Shapiro and Varian, 1999).

(2) Bergeron and Raymong (1992) and Thong *et al.* (1997) have suggested the use of "Electronic distribution technologies" (EDTs) to provide collaborative groups with the ability to link large numbers of information units in a dynamic manner. EDTs not only support communication but also the creation of social networks of members narrating and sharing their stories, e.g. a brainstorming session organized amongst people communicating by e-mail.

(3) "Basic PC technologies" (PCT) are elements whose presence will facilitate the storing of knowledge and its subsequent retrieval in a shorter period of time (Lee and Runge, 2001). For example, PCTs support the user in his/her interpretations through tools to help make decisions. Therefore, PCTs facilitate the easy search and retrieval of relevant knowledge from the repositories, and enable the users to apply this knowledge in decision-making (Fowler, 2001).

According to Bueno (1998), relational capital is defined as the value of relationships that an organization maintains with its environment; whilst according to Onge (1996), customer capital is the knowledge created by the relationship that an organization maintains with its customers. Day (2000) also recognises the importance of customers because of their direct relationship with financial performance and long-term survival. Among all the indicators of customer capital Bueno (1998) suggests three key components, i.e. quality, market reputation and customer satisfaction.

Client satisfaction is the perception between created expectations, and that which he or she has received on the product or service. Quality can be understood as the set of characteristics of a product or service that satisfy the client's necessities (Feigenbaum, 1983; Juran, 1996). These implicit and objective client's necessities can be satisfied by an improvement in feedback learning (Gronroos, 1984). For example, by knowing how customers perceive the company's products and services (Babakus and Mangold, 1992), the organization will be able to adjust products and services to clients' expectations, improving customer satisfaction and encouraging further purchase, as well as positive recommendations to other clients (Day, 2000). Therefore, depending on whether organizations exploit knowledge correctly or incorrectly, they have the potential to fortify or debilitate the public opinion about a company or its brand (Cegarra and Rodrigo, 2003).

3. The empirical study and factor analysis

A survey was designed to investigate the relevance of three key components of four variables:

(1) the degree of technological systems;

(2) the creative destruction;

(3) the feedback learning; and

(4) intellectual capital identified in the literature of the Spanish technology and information systems sector and how these variables might be related.

Previous to the accomplishment of the personal survey, the companies were informed by post of the work objectives; they were assured that it was of a strictly scientific and confidential nature and that the data would be treated in a global and anonymous manner.

The questionnaire was initially validated by academics in knowledge management in Murcia and Cartagena (Spain) and with managers of a pilot sample of five leading Spanish companies in the field of technological and information systems. From a population of 253 companies, the total number of surveys that were completed was 160 companies. However, by contrasting each hypothesis, only 151 cases where all the relevant questions had been answered were considered. According to Hair *et al.* (1999) and Sekaran (1992) the size of the sample was considered sufficient as it is greater than ten times the number of predictors from the indicators on the most complex formative construct or antecedent construct leading to an endogenous construct. Details of the sample are shown in Table I.

In order to determine the presence of a technological system, only one measure is necessary to show us a reference point about IT, EDT, and PCT. For this aim, we asked the manager or general director of the SMEs about the presence of some technologies and application systems. He was asked to indicate, (1) they had this application or (0) they did not have this application. Articles shown in Table II used questions (1-8) to measure IT; questions (9-16) to measure EDT; and questions (17-24) to measure PCT. According to their answers, we found three new variables with a minimum value of 0 and a maximum value of 8. The confirming factorial model, such as is shown in Table III, proved that these three new proposed dimensions (IT, EDT, and PCT) are defining only one principal factor; the technology system (TS).

Feedback learning (FB) and creative destruction (CD) were measured using a total of six items. In these questions, the manager or general director had to indicate his degree of agreement or disagreement on a Likert scale of seven points (1 = high disagreement and 7 = high agreement). Table III shows articles (4-6) used to measure the CD, and articles (7-9) used to measure the FB. Intellectual capital (RC) was measured using questions (10-12). In RC questions, managers of the SMEs had to indicate the position of their companies with respect to their competitors on a Likert scale of seven points (1 = much worse and 7 = much better).

The evaluation of psychometric properties in each of the measurement scales used for different constructs is based on methodological suggestions developed by Churchill (1979) and was validated for convergence and discrimination (Anderson and Gerbing, 1988; Lehmann *et al.*, 1999).

Results of the confirmatory factor analysis and reliability of the scales are shown in Table III. In all cases the coefficients of reliability exceed the minimal level of 0.6 recommended by Bagozzi and Yi (1988) confirming the reliability of each construct.

Population	253 companies of the technological and information systems sector of Spain
Type of data collected	Structured questionnaire/personal survey
Size of the sample	151 SMEs (response rate of 59.70 per cent)
Factor of error	± 5.1 per cent (level of reliability of 95.5 per cent)
Date of the field work	From early June to mid-July 2001

Table I.
Survey characteristics

What technologies are used by your company?		
1. Own web	Yes	No
2. Do you have a catalogue on internet?	Yes	No
3. Mail order business	Yes	No
4. Open distribution lists[a]	Yes	No
5. Open discussion groups[a]	Yes	No
6. Open voting systems[a]	Yes	No
7. Do you know the number of visits to your web?	Yes	No
8. Do you know where they are from?	Yes	No
9. Discussion's list and distribution's list...(inside)	Yes	No
10. Access to share data base	Yes	No
11. Repository of documents	Yes	No
12. Case base reasoning	Yes	No
13. Voting systems	Yes	No
14. Workflow	Yes	No
15. Team calendars	Yes	No
16. Simulations of business processes	Yes	No
17. Planning and programming of production	Yes	No
18. Stock management	Yes	No
19. Commercial management	Yes	No
20. Accounting, finances and invoicing	Yes	No
21. Employee management (human resources management)	Yes	No
22. Tools to help in making decisions	Yes	No
23. Creation and updating of webs	Yes	No
24. Tools of engineering of software	Yes	No

Note: [a]Open because external agents of the organization can participate without any restriction

Table II.
Summary of survey technology system items

Using the correlation matrix results as an initial guide, the fit statistics for the 12 measurement constructs were: $\chi^2_{(48)} = 95.66$; GFI = 0.90; CFI = 0.91; IFI = 0.92; RMSEA = 0.07.

Convergent validity was assessed using the *t*-statistics for the path coefficients from the latent construct to the corresponding items. According to Anderson and Gerbing (1998, p. 16), "convergent validity can be assessed from the measurement model by determining whether each indicator's estimated pattern coefficient on its posited underlying construct factor is significant (greater than twice its standard error)". As shown in Table III, all path coefficients from the four constructs to the 12 measures are statistically significant, with the lowest *t*-value for the items measuring RC effectiveness being 6.26. All the *t*-values considerably exceed the standard of 2.00 and the standardized parameters (>0.5). This puts the convergent validity of the five constructs at a 99 per cent level of reliability.

Discriminant validity was assessed in two ways (Baker *et al.*, 2002). First, the confidence interval for each pairwise correlation estimate (i.e. $\pm$ two standard errors) should not include 1 (Anderson and Gerbing, 1988). Table IV shows that this condition was satisfied for all pairwise correlations in the measurement model. Secondly, the percentage of variance extracted from each construct should exceed the construct's shared variance with every other construct (i.e. the square of the correlation) (Fornell and Larcker, 1981; Hult *et al.*, 2000). For example, the extracted variance for TS is

Item description	Standardized loading	*t*-value	Reliability SCR
Degree of technologies systems (TS)			0.728
1. Internet technologies (IT)	0.57	6.53	
2. Electronic distribution technologies (EDT)	0.77	8.47	
3. Basic PC technologies (PCT)	0.71	7.96	
Creative destruction (CD)			0.773
4. Workers of the company have abilities to communicate with others members that form part of the organization	0.63	9.36	
5. Workers of the company are not intimidated by problems, they face up to them and solve them	0.79	9.47	
6. Workers participate in social events (formal or informal)	0.68	6.09	
Feedback learning (FB)			0.721
7. Meetings with customers are maintained frequently	0.68	7.72	
8. Collaborations with customers to improve products and services are maintained frequently	0.72	8.13	
9. Informal activities (dinners, lunches, and travels) in which customers and employees participate are organized	0.64	7.33	
Intellectual capital (RC)			0.710
10. Improvement of the quality	0.51	6.26	
11. Good reputation and prestige	0.63	7.65	
12. Satisfaction of the clients	0.83	9.49	

Notes: The fit statistics for the 15 measurement constructs were $\chi^2_{(48)} = 95.66$; GFI = 0.90; CFI = 0.91; IFI = 0.92; RMSEA = 0.07: with scale composite reliability (SCR) of $\rho_c = (\sum\lambda_i)^2 \text{ var } (\xi)/[(\sum\lambda_i)^2 \text{ var } (\xi) + \sum\theta_{ii}]$

Source: Bagozzi and Yi (1988)

Table III.
Construct summary, confirmatory factor analysis and scale reliability

	φ_i	ε	$(\varphi_i + 2*\varepsilon)$	Shared variance	Extracted variance
TS → CD	0.31[a]	0.09	0.49	0.10	TS: $\rho_c^{AVE} = 0.475$
TS → FB	0.07	0.11	0.29	0.00	
TS → RC	0.03	0.08	0.19	0.00	
CD → TS	0.31[a]	0.09	0.49	0.10	CD: $\rho_c^{AVE} = 0.527$
CD → FB	0.04	0.1	0.24	0.00	
CD → RC	0.01	0.08	0.17	0.00	
FB → TS	0.07	0.11	0.29	0.00	FB: $\rho_c^{AVE} = 0.463$
FB → CD	0.04	0.1	0.24	0.00	
FB → RC	0.33[a]	0.08	0.49	0.11	
RC → TS	0.03	0.08	0.19	0.00	RC: $\rho_c^{AVE} = 0.462$
RC → FB	0.33[a]	0.08	0.49	0.11	
RC → CD	−0.01	0.08	0.15	0.00	

Notes: [a]$p < 0.01$; [b]$p < 0.05$; [c]$p < 0.1$. Average variance extracted $(\rho_c^{AVE} = (\sum\lambda_i^2 \text{ var}(\xi))/[\sum\lambda_i^2 \text{ var}(\xi) + \sum\theta_{ii}]$

Source: Fornell and Larcker (1981)

Table IV.
Cross loading and discriminant validity for each pairwise of constructs

$\rho_c^{AVE} = 0.475$, which exceeds its shared variances with CD (0.10), FB (0.00) and RC (0.00). As may be seen in Table IV, discriminant validities among all pairs of constructs in the measurement model are also satisfied for all the constructs.

4. The structural model and hypotheses

Organizations outgrow their ability to exclusively use spontaneous interactions to interpret, integrate, and take coherent action. This communication may also occur by the utilization of information technology. But unless the creative destruction is also facilitated by technology systems, employees do not get enough information to understand what they need to do in order to improve (e.g. using technology, employees may understand whether or not they need to improve how they tell learners about their performance in comparison to other people in the company). Therefore, in the process of the creation of intellectual capital, it is recommendable to achieve a technology system that fosters the adequate (feedback) learning process, in which individuals and groups reject their obsolete mental models and open their minds to that which is necessary to develop. Under this framework the hypotheses that we propose are:

H1. The higher the level of the technology systems, the higher the level of the creative destruction.

H2. The higher the level of the technology systems, the higher the level of the feedback process.

Creative destruction involves systems of coordinated relationships among members of the company in which people interact to carry out routines or solve problems using the current technology systems (Fiol and Lyles, 1985). However, an organization cannot establish a new routine if it has not previously been stored in the organizational memory, therefore old structures and ways of thinking must be removed from the repertoire to make room for new structures.

We also test whether "the creative destruction" is a prior step (the null hypothesis) against the alternative (that "the creative destruction" is not a prior step) in the creation of intellectual capital, i.e. the feedback process and the creative destruction could be undertaken in parallel or is unnecessary in the creation of intellectual capital. Consequently, we propose the third hypothesis of the work.

H3. The higher the level of creative destruction, the higher the level of feedback process, and the lower the level of (relational) capital.

At present there is a growing consensus on the idea that those organizations that are learning will obtain an occupational climate which is more conductive to intellectual capital development (Argyris and Schön, 1978; Fiol and Lyles, 1985; Senge, 1990; Dodgson, 1993; Nevis *et al.*, 1995; Schwandt and Marquardt, 2000). This consideration allows us to frame the fourth hypothesis of the work.

H4. The higher the level of the feedback process, the higher the level of (relational) capital.

The results of the structural model shown in Figure 1 and hypothesis tests using Lisrel (Steenkamp and Van Trijp, 1991) are presented in Table V.

In testing the null hypothesis, Table V shows that TS had a positive influence on CD, it was significant with a coefficient of 0.13 with a level of $p < 0.01$. However, although TS in the model had a positive influence on FB it was not significant with a student t-value of 0.67. The effect of CD on FB had a standardized coefficient of 0.06 suggesting a positive influence on FB. Table V again shows that FB with a coefficient of 0.57 with a level of $p < 0.01$ had a significant effect on RC. Consequently, we can assert that TS have a positive influence on CD.

In testing the alternative hypothesis, Table V shows that TS with a coefficient of 0.05 do not have a significant effect on FB whilst the TS show a significant effect on CD with coefficients of 0.13 and level of $p < 0.01$. Table V shows that CD had a negative influence on RC with a student t-value of 0.65. Table V again shows that FB with a coefficient of 0.57 with a level of $p < 0.01$ had a significant effect on RC. Consequently, feedback process has a significant and positive effect on relational capital in null and alternative hypothesis.

5. Discussion

This study has examined two key constituents of the learning process (the feedback process and the creative destruction) and their effects on the "intellectual capital". A null hypothesis (that "creative destruction" is a prior step in the feedback process) was tested against the alternative hypothesis (that "the creative destruction" is not a prior step, i.e. could be undertaken in parallel or is unnecessary in the creation of intellectual capital) through an empirical study of 151 SMEs in the Spanish technology sector through structural equation modeling.

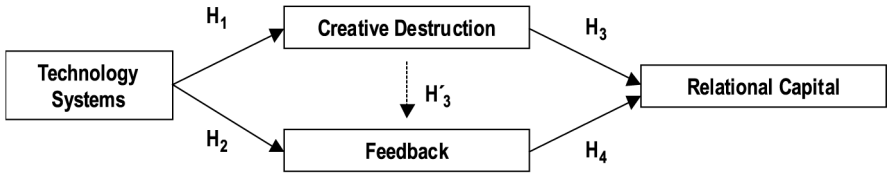

Figure 1.
The theoretical structural model

	Null hypothesis (H_N)		Alternative hypothesis (H_A)	
	Estimates	t-value	Estimates	t-value
TS → CD	0.13	2.66[a]	0.13	2.66[a]
TS → FB	0.07	0.67	0.05	0.65
CD → FB	0.06	0.35	–	–
CD → RC	–	–	−0.05	−0.20
FB → RC	0.57	3.68[a]	0.57	3.69[a]
	$\chi^2_{(50)} = 95.75$; GFI = 0.90; CFI = 0.92; IFI = 0.92		$\chi^2_{(50)} = 95.70$; GFI = 0.90; CFI = 0.92; IFI = 0.92	
CDT	Chi-square difference = 0.05			

Notes: [a]$p < 0.01$; [b]$p < 0.05$; [c]$p < 0.1$

Table V.
Construct structural model

The results indicate that "the creative destruction" depends on the technology system of the company. Furthermore, if "the creative destruction" is a prior step in the feedback process, then the feedback process is influenced more by "the creative destruction". These findings are significant, since they introduce the traditional focus of a technology system at the feedback learning process. Specifically, results show that the feedback process is more closely related than creative destruction to relational capital. This suggests that companies may be over-investing in the development of creative destruction, and under-investing on mechanisms to facilitate the flow of feedback process.

These findings support the views of Malhotra (2000) that what is done with data and information depends upon subjective interpretation of individuals and groups that transform these inputs into actions and performance. In other words, companies need to provide and support several categories of knowledge management capacities, e.g. leadership and company culture through the deployment and integration of currently available technologies (Gold *et al.*, 2001). In this way, CD will have an impact on RC, although this effect will not occur directly, but through its effect on FB and the effect of FB on RC.

In conclusion, despite the majority of companies having connections to the internet, managers do not know the potential business benefits of technology systems for their clients, individuals and teams. They do not research the technology system properly, and ignore the problem of "human integration". These circumstances are identified as reasons for the technology systems failure in the Spanish technology sector. Therefore, considerations should be given to how existing technologies could foster the creative destruction (e.g. rules, and procedures to discard obsolete knowledge) as a prior step to foster feedback process, otherwise the implementation of technology systems in the feedback learning process is not so successful.

The study is not without limitations and consequently any conclusions might not be generalisable. First, although the technology industry falls clearly within the category of SMEs they might not be representative of all SMEs because of the types of products and services that they sell. Secondly, national cultural issues might influence how organizations learn and consequently influence the learning process. Third, we are able to provide only a snapshot of ongoing processes and not measures of the same process over time. The major limitation of our study concerns our measurement approach. Although the constructs have been defined as precisely as possible by drawing on relevant literature, and validated by practitioners, they can realistically only be thought of as proxies for an underlying latent phenomenon that is itself not fully measurable. Moreover, other factors which have not been included in this study, are also likely to affect the learning and unlearning processes.

Taking the limitations into account, this study points to the need for new avenues of research. First, we consider that the use of additional items might help to capture the rich construct to a greater extent. Secondly, depending on learning culture and leadership used by the company, some technologies will be more successful than others. Therefore, we propose a complementary study on the technologies used by the company depending on its learning culture and leadership. Thirdly, another possible research direction could examine the life-cycle effects on technology systems. Finally, this paper suggests that longitudinal research may be needed to examine the

relationships among technology systems and CD and the ways in which they affect FB and RC.

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