New technologies and their relationship with quality and human resources in the Spanish hotel industry.

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Abstract
Technology has been playing, in different ways, an important role in the profit strategy of tourism companies, which have, perhaps myopically, implemented new technologies without making an appropriate study of the costs and benefits that are necessary for implementation. The questions that are considered to be most relevant in regard to this are: how important are the new technologies adopted for tourism companies? And how do these new technologies relate to competitiveness and competition positioning of tourism companies? How are new technologies related to human capital skills? The research reported below attempts to develop these topics within the context of the Spanish hotel industry using an ad hoc survey designed for this purpose. After providing an a priori analysis of the theoretical relationship between these variables, subsequent empirical tests show interesting and statistically significant interrelationship between quality, innovation and human resource skills.

Key words: quality, training, technological innovation and hotel companies in Spain.
Every company, big or small, participates in technological change as an initiator, user or victim of it.

1 Introduction

Technology is a combination of theoretical-empirical knowledge that is used in the production and marketing of goods and services, which can be incorporated into the production team or which can become embedded as professional experience or as abilities and knowledge applied to the running of the business (Forman, 1982).

The discoveries and innovations emerging in the field of high technology-communications and information technology (CIT), are the main of dramatic transformations that economy and society have been undergoing causes over the last 30 years (Amendola and Gaffard, 1988), and which have caused profound transformations in the economic and social structures of all sectors of economic activity (Davies, 1979; Mansfield, 1961).

Knowledge and information have become increasingly important in production and marketing, leading to a mushrooming recognition of a “knowledge economy” and “knowledge management” as salient factors in the second industrial revolution.

The tourism sector is equally heavily influenced by new technologies (NT) (Sheldon, 1997), and has been forced to make a series of changes in two main domains: changes in working methods as applied to the development, production and marketing of tourism activities, as well as changes in specifically technical fields of production. Similarly, other tourism sub sectors have also dynamically adapted NT, for if they want to guarantee their survival in the medium and long term, they’ll be forced to innovate, which means obtaining new products and/or using new processes.¹

Technological change is creating new business models that incorporate continuous change as a strategy (Geroski, 2000). This doesn’t merely imply having a web page or a computer expert; for changes are much more profound, taking place throughout all working processes and affecting each department in tourism firms.

These issues, in the same way as quality criteria were extremely important in the 80’s to ascertain the long term health of tourism companies, have, at present, become a new criterion in the form of considering technological development in itself as a competitive strategy. Although technology plays an important role in the profit strategy of tourism companies in general, and in the hotel industry in particular, companies have made technology a priority without however fully appreciating the costs and benefits inherent in these structural changes.

The adoption of new technologies always comes with direct and indirect costs, and with constraints in the form of new funding, quality and flexibility, possibly to the detriment of other important enterprise activities and measures, such as e.g. the maintenance and improvement of quality and resources in training. Given that the hotel sector is a service sector, the human element is a very important factor both through the service encounter and in the development of the standard of quality and technology in companies in this sector.

A quick and efficient way to make the most of innovation diffusion is for the company to have an innovation capacity that can solve the problems that arise in the day-to-day running of the business. It is also important that there be a appropriate training system to adopt employees to new technologies.

The capacity of innovation in tourism companies in general, and in the hotel industry in particular, is typically related to the quick application and absorption of information and telecommunication technologies, which is fundamentally conditioned by the workforce and its level of qualification in these new technologies (Asplund and Vuori, 1996). Given the characteristics and size of tourism companies in the industry (dominance of medium and small companies), diffusion processes may however be slow for SMES¹ in comparison to big tourism enterprises (Sancho and Maset, 2001) and/or the dynamics of other industrial and service

¹ This is true for the food and restaurant industry, for travel intermediation and hotels.
sectors (Benavides, 1998). Similarly, poor training of workers within the sector can slow down the diffusion of technology (Ballot et al., 1997; Lope Peña, 1996). Another key theoretical question to be raised in this context is concern for the question as to the innovation has for employment, skills, productivity, and quality in the tourism enterprise. Thus the focus of this work to be reported below is analysis of innovation strategies of hotel companies and its relationship with the level of service quality and the embedded human capital. The study has been carried out for the hotel industry as sample for further analysis using an ad hoc survey of hotel companies. A methodological diagram is developed in section two of this article as a guiding framework to use as a reference in following the objective of this work. In section three an analysis of the Spanish hotel sector is carried out reporting analytical results and drawing policy conclusions. Section four closes with overall conclusions and a research outlook.

2. On a possible nexus between new technologies, learning/training and quality (business) performance.

The relationship between the pursuit of new technologies, the requisite learning/training or general know-how acquisition and the achievement of business (quality) performance is based, here, on the assumption that the majority of SMEs are not able to compete with lower cost and prices through a cost leadership strategy, but can only survive and flourish using a differentiating strategy through innovation (Porter 1990). That is not to deny that most innovations in the hotel sector may be process oriented and aimed at reducing cost, but simply suggests that possible cost savings through innovation be passed on to improve the quality of products or services since the latter constitutes the only viable strategy for the majority of SMEs in tourism.

Large tourism enterprises (such as hotel chains) try to raise quality to levels that are similar to their market positioning (e.g. brand or star category). At the same time, they have the capability to pass on some of their innovation dividends to clients in the form of lower prices, thus pursuing a cost leadership strategy (Porter 1990).

In short, innovation in all branches of economic activity, including the hotel sector, is undertaken to raise profits through lowering costs or increasing revenue (Mansfield, 1961) which results in a better business model and better business performance and market position, particularly in regard to the achievement of high levels of quality of service.

Therefore, an initial working hypothesis might suggest that there should be a positive relationship between business performance, in general, and a high level of quality and differentiation in particular, and the degree of innovativeness or level of innovation within the tourism enterprise in question.

Although technological change or innovation usually requires a substantial amount of financial capital and assumption of risk under either a “make or buy” decision rule, human capital is also required. The latter can be provided in the form of either new employees, additional training and/or the restructuring of work (Weiermair, 1993). Whatever the nature of the technological change, training, restructuring of work and/or the acquisition of human resources will be required both at the strategic level, dealing with the strategic choice of technological alternatives, and at the operational level, dealing with the implementation and use of technology to provide an optimal mix of “high tech and high touch” (Weiermair, 1993) leading to high levels of quality of service.

Both know-how, human resources and quality should be understood as being complex (multidimensional) and dynamic, which implies that they are best understood from an intertemporal perspective. Thus innovation and training appear to have substantial scale and option return effects in the sense that the more training is done, the easier it is to further increase its level. Similarly, the more science based and/or innovation experienced companies are the easier it will be for these firms to continuously research and innovate.

This leads to a second hypothesis which suggests that firms who have already obtained high levels of quality (in terms of complexity) and hence have a more highly trained workforce
available will find it easier to adopt new technologies than firms who have not positioned themselves in terms of quality differentiation, innovation and product development.

From this point of view a number of theoretical studies (...) have shown that the integration of new technologies in the business model is a very valid instrument in improving the competitiveness of companies. In the tourism sector, in general, and the hotel industry, in particular, the diffusion of new technologies depends on the capacity of the workforce to manage them. Some of the benefits that new technologies provide to hotel companies are: an increase in competitive capability (lower prices due to the reduction of costs or new products appearing), development of markets, higher productivity, quality improvement, modernisation in the way that the company competes, more market penetration and diversification (Buhalis, 1996). However, this process is not possible without the specialisation of the human capital that manages the hotel industry, (see figure 1).

**Figure 1: The relationship between innovation, human capital, productivity and competitiveness.**

![Diagram showing the relationship between innovation, human capital, productivity, and competitiveness](chart.png)

Source: self elaboration

The model that this paper proposes comes from establishing a disjunctive between the level of technological intensity implemented in hotel companies and quality and training indicators of the hotel industry in Spain. For this purpose a technological intensity indicator (IT) is created, taking into account the percentage of new technologies implemented in each hotel in relation to a reference group that includes the new TIR and new production technologies. Innovations carried out in the hotel industry firms have been classified into four large groups or categories: innovation in information and communication technology (ICT), innovation in the productive process (IP), innovations in management processes (MP) and total innovations (IT). A list of innovations in each group can be found in Annex 1. The innovation variable has been defined as the quotient between the number of innovations adopted in a hotel and the number of potential innovations. Therefore, the endogenous variable is a limited variable that has a value between zero and one.

When taking into account the quality indicator (QT) of companies, a group of variables have been considered to define the position of the company in regard to diverse factors such as quality certificates obtained (ICTE; ISO; EFQM; and others), as well as another group of variables that will delimit the competitiveness of Spanish hotel companies. These variables assess the quality levels of the company. The variable QT is obtained as a ratio of the quality standards the company has over the total of standards considered. This variable is, therefore, a percentage, and thus has a value between zero and one, in a similar way to the IT variable. The positioning of these variables in the Cartesian axis is such a way that the technological intensity indicator (IT) is on the Y axis, and the quality indicator (QT) is measured along axis X, as shown below in Figure 2.

**Figure 2: Characterization of firms in terms of the differentiation:**

![Diagram showing the relationship between technological intensity and quality](chart2.png)
The figure gives an overview of possible technology positions of enterprises, where four different positions that delimit both the incorporation and adaptation levels of technology strategies in Spanish hotel companies can be distinguished. These four groups are:

Group I. - Companies with high technology but poor quality levels.
Group II. - Companies with poor technology and quality levels.
Group III. - Companies with high quality levels and poor technology levels.
Group IV. - Companies with high quality and technology levels.

The group of companies that belong to Group I have high technology levels, but the technology hasn’t been implemented correctly and hence its strategic value in the market is very poor. These companies haven’t been successful in their technology incorporation strategy so they will have to rectify their quality criteria. Their philosophy has been to concentrate on technology only while neglecting basic quality performance problems. Put differently their technology gills have been too high resulting in inefficiency and technology frustrations, and a poor income-yield capacity ratio.

The group of companies located in Group II have very little chance of market survival in the short or medium term without a quality/technology change of strategy. Due to their poor technology and quality levels these companies should consider change in their future strategy. To be able to move into a more successful category they should transform their technology strategy, as well as consider changes in the methods and capabilities of traditional production and in the company’s relationship with the market.

The companies located in Group III, with high quality levels, are well positioned for long-term success. Their effort should be focused on increasing their technological capacity in order to be able to respond to business demands, and to their clients with high technological demands. An appropriate NT investment is likely to be highly beneficial to these companies.

The group of companies in Group IV have a technology business model with high quality levels, and therefore their companies are successful companies with sustainable growth potential. These companies are the leaders in the sector and have a good relationship with other businesses in the marketplace. These positions are summarised below in Figure 3.

Source: self-elaboration
Training and innovation in tourism companies in general and in the hotel industry in particular

The significant relationship between investment in training and the stimulation of innovation processes in the framework of industrial companies has been clarified and expounded upon in diverse studies, but despite the importance of the human element in the technological development of the tourism and hotel sector, very few studies have examined the synergy between innovation and characteristics of the human element.

The adaptation of tourism companies to innovations relies heavily on the ability of their professional managers. Success in tourism depends on how well their present and future workforces are prepared (Jafari, 2002). An increase in training is necessary to materialise innovations, because technological applications require the repositioning of skills among workers and companies to suitable levels. Companies increasingly require more complex skills, so there is an increasing need for effective and systematic training in the workplace. It has also been demonstrated that a significant educational component is involved in any kind of job shaped by work experience (Shepherd, 1995). Recycling is necessary because new skills require a higher or different level of knowledge. If a company is interested in retaining its human capital, it will have to provide whatever is necessary for its adaptation to the new situation (Sinoway, 1997).

It is generally true that a correct training policy aimed at becoming competitive in the market place must be a priority for any tourism company. The training should be systematically orientated towards the objectives as set out by companies facing their own specific technological challenges.

To carry out an innovation process successfully, a company must include all necessary knowledge in and devote the necessary financial and human resources to its production or manufacturing process. Part of this knowledge is technological, but it also involves such domains as management, copyright, financial instruments, market prospecting, to name the more salient ones. The innovation process requires companies to make an effort in regard to training time, mainly in R&D activities, and in the education and training of its workers in order to guide the development of innovations (Stamboulis, 2003). The company must also make a parallel effort...
with regard to the accumulation of scientific knowledge and information. This leads to innovation having an accumulative character, which means that future possibilities constantly depend on the achievements in the past, and that training represents an increase in the qualification levels of the workers in the sector.

The tourism industry today requires more complex skills that need more and more investment in R&D, which should be effective and systematic (.....). The general assumption to be followed will be for innovation to be complemented by the effort made in training in small and medium companies, allowing tourism companies to obtain higher benefits and efficiency levels.

The complete process between training needs and innovation is summed up below in Figure 4.

1. The first step in the process prior to innovation is to discover the uses new innovations have for the company. Therefore, training at management levels is important, in order to be able to assess opportunities which markets of innovative ideas offer, and to consider possibilities of adopting them.

2. It is essential in the second stage to determine what might be the most important type of innovation for the company. Thus it is necessary that staff be trained well enough to be capable of understanding the business possibilities which new technologies offer and the possibility of implementing them in their service process.

3. Finally, it is necessary to develop a process that makes the implementation of innovations more efficient. As a result, good training levels aimed at the semi-skilled workforce are essential. It is important at this juncture to do everything possible to reengineer the entire process and adapt it to new technology levels.
The organisation-specific situation of a company should be analysed when assessing training requirements, taking both its technology level and its training characteristics into account. The technological indicator IT has been used in this study as an innovation index. In the same way a company training indicator (EI) or training index has been defined, in which a group of variables including training aspects of employers hotels has been taken into consideration. This index has been obtained by considering the influence of a group of variables which define the training
approach of hotel companies in relation to the basic training of workers, types of contracts, training sensitivity on the part of the companies and their training strategies.

In this way, hotel companies can be positioned into on Cartesian axis in such a way the training indicator is situated in the X axis, and the technology intensity in the Y axis. The companies located in each square share a series of characteristics, which are summed up in the following diagram:

Group 1: High technology level but low training level. The necessary strategy to be followed by the company in this case should be to increase the specific training of workers in new technologies, with the purpose of making innovations more profitable, and therefore establishing a competitive advantage.

Group 2: Low technology and training level. Here increased investment in new technologies and training is necessary. If the company wants to maintain a long-term competitive position in the tourism market, it will have to make efforts to adapt to technological advances, train appropriately and apply them to the business, thus increasing its value.

Group 3: High training and low innovations level. In this group, companies have a good basis for improving their technological position. Since the majority of companies are medium and small companies, it could be potentially more expensive to invest in Information and Communication Technologies (ICT) than in the training of staff. A solution that would allow these companies to reach group 4 would be to resort to public funding in terms of subsidies on tax reliefs in order to obtain a technological advantage for the future, for their level of human capital can absorb innovations.

Group 4: These companies have a sound technological strategy and suitable training quality. They are business leaders and are in a good position to confront new technological challenges, and at the same time obtain business results.

Figure 5. Hypothetical relationship between level of technology (TI) and training level (EI) in hotel companies.

An empirical account of technology and quality structures in Spanish hotel companies

In order to empirically test the hypotheses advanced above study for the Spanish tourism sector has been conducted from where information related to the hotel sector was retrieved.
Information has been obtained through research carried out for this specific purpose in drawing a representative sample from the aforementioned hotel groupings. A sampling frame was developed representing all Spanish regions and all hotel categories in terms of (stars). The total number of hotels included in the sample was 225. The sample was weighed by provinces and categories with the hotels to be interviewed being chosen randomly from the clusters. Another sample characteristic has been the division between hotels with the quality seal (A) mark from the Spanish Tourism Organisation of Spain (ICHE) and those without it.

Results of the analysis

The construction of heuristic model and its empirical counterpart as expressed in the sample has helped clarify existing relationships between quality levels and technological developments. When analysing the abovementioned variables, we find a strong positive correlation between them. The empirical analysis included all of the components which are part of the quality index variable and their relationship with the technological change in the company. In this way it was possible to observe the significance of the variables “existence of quality auditing” and the “existence of quality circles” as important factors in determining greater levels of technology development. The relationship that exists between innovations in technology and the management and planning of regular hotel business they have seem as equally important. That hotels survey to evaluate quality and that loyal client cards constitute other important features of quality.

Another important finding is a strong correlation found between companies that used a ISO1400 / EMAS quality plans and their strong position in innovation. These findings, encountered in the study of correlations between the above described variables, make clear that technological innovation is greater in companies who have a good control over their operational planning and who make an effort to be in high quality standing. When positioning the information summed up in the quality index and technology information in a Cartesian diagram, as postulated in the previous paragraph, it can be observed that hotel companies which are in Group IV (high quality and technology levels) to show the efforts which hotel companies are making in the pursuit of quality and technology represent a very large percentage e.g. 37.3%.

Figure 6. Duality between technological innovations (TI) and quality efforts (QI)(all hotels in Spain).

Source: self-elaboration using sample results

In this context it is important to highlight the efforts which Spanish companies have to undertake in order to move into levels of Groups III and IV.
The large percentage of hotels in Group II (30.7%) is evidence of structural problems in terms of a lack of appropriate quality and technological levels in many Spanish hotels. For hotel companies to be able to attain more competitive positions, it is first of all necessary to examine the technical potential available in order to assess which NT should be considered, and what niche at the present time the company has in the market in comparison to its most important competitors. The next step is to define the company’s technological needs in terms of investments in NT. Next in order to move to Group level III or IV, firms must carry out efforts to install and reinforce quality management programmes. For this to happen technological and quality priorities have to be combined. No doubt this should be the future strategy adopted by hotel companies.

Another area which has been investigated in the study has been the relationship between the technological position of hotel companies and the specific profile of their employees. Results obtained in a first approximation have shown the importance of training in developing efficient innovative strategies. The strong correlation found between the technological innovation index (TI) and the training index (EI) as shown in the previous paragraph can be taken as proof of this. Not all of the variables considered within this training index however have had the same impact on the innovation record of companies. It has been found important for companies to have a detailed training plan for their employees in order to achieve a better innovative position (see figure 7), and it was found important that this training be given by the companies’ own personnel. The presence of computer experts in hotels has also been found important (see figure 8). Subsequently personal and educational profile of workers were analyzed in terms of their relationship to innovative activities. The sample showed positive relations between innovation levels and a workforce which averaged 25-35 years of age while displaying negative correlation for managerial staff of 46 and above. This can be easily understood in the context of a highly fragmented and small scaled Spanish hotel industry with little managerial talents and training where traditional companies have not as yet embraced technological change, while on the other hand a new generation has taken over or moved in and has also taken up the technological challenge which explains the polarization of technology and quality across the two groups.

The results obtained point suggest that the proportion of innovations adopted by hotels is positively related to the provision of training programs. Profitable training therefore should be specific to the companies’ needs and requirements and such that it cannot be easily transferred to another company. In this way, a company reduces the risk of training employees for another company. At the same time can the age of the manager have a negative impact if he/she falls into the age category of 46 to 55 years of age, particularly when a new employee has to be hired to meet the demands of a new technological adaptation. It appears more important that a hire should have the experience or profile suitable for the specific position, rather than or a specific qualification.

**New technologies and subsidies**

Here we present work involving analyses concerning financial sources of new technologies in hotel companies. As can be seen in figures 8 and 9, financial sources have been considered (company’s own sources, local subsidies, European commission subsidies, from the national department of tourism department and other departments). The study has carried out a cluster analysis, and as can be seen in figure 8, 1 & 5 star companies mainly finance innovations with sources of their own. Hotels with less stars finance their innovation projects with state sources of funds which in the main come from the national tourism department.

As can be seen in figure 8, the most innovative companies are not the ones which receive most help from the National department of tourism.
Econometric model

Using information provided by the sample the following models have been estimated. Table 1, displays the totality of models built and estimated with respect to the relationship between the technological index and a battery of variables containing: characteristics of the company, staff characteristics, strategic plan, origin of the financing of the technological investments and training strategies of the company.

The endogenous variables have been defined as the quotient between the amount of innovations of a company and the total of innovations carried out, as has been set out in section 2 of this study.

Table 1: Models Estimates

<table>
<thead>
<tr>
<th>Endogenous variables</th>
<th>Total innovations (IT)</th>
<th>Innov. in TIC/NT</th>
<th>Innov. in production (IP)</th>
<th>Innov. in management (IG)</th>
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<td>Characteristics of company</td>
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<td>Model 11</td>
<td>Model 21</td>
<td>Model 31</td>
</tr>
<tr>
<td>Characteristics of company + management</td>
<td>Model 2</td>
<td>Model 12</td>
<td>Model 22</td>
<td>Model 32</td>
</tr>
<tr>
<td>Characteristics of company+ Quality of strategic plan</td>
<td>Model 3</td>
<td>Model 13</td>
<td>Model 23</td>
<td>Model 33</td>
</tr>
<tr>
<td>Characteristics of company + origin of funding</td>
<td>Model 4</td>
<td>Model 14</td>
<td>Model 24</td>
<td>Model 34</td>
</tr>
<tr>
<td>Characteristics of company+ Own subsidy</td>
<td>Model 5</td>
<td>Model 15</td>
<td>Model 25</td>
<td>Model 35</td>
</tr>
</tbody>
</table>

*Central government subsidies
*European subsidies
*Local subsidies
*Own subsidies
*Other subsidies

*Subvenciones estatales (otros ministerios)
*Local government subsidies
*Own subsidies
*No subsidies

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On analysing the models presented in table 1 the three that offered the best results (table 2) have been chosen. The following conclusions have been draw from them.

**Tabe 2: Statistically significant models and model results**

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>MODELO 1</th>
<th>MODELO 3</th>
<th>MODELO 8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constant</strong></td>
<td>0.0153 (0.1226)</td>
<td>-0.0146 (-0.1332)</td>
<td>0.0474 (0.4383)</td>
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<tr>
<td><strong>Log(Plaz/Trb)</strong></td>
<td>-0.0372 (-2.3092)</td>
<td>-0.0269 (-1.8844)</td>
<td>-0.0262 (-1.8607)</td>
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<tr>
<td><strong>Q</strong></td>
<td>0.0933 (3.3024)</td>
<td>0.0711 (2.8651)</td>
<td>0.0491 (2.0088)</td>
</tr>
<tr>
<td><strong>Estr</strong></td>
<td>0.0274 (2.0467)</td>
<td>0.0247 (2.0983)</td>
<td>0.0253 (2.2310)</td>
</tr>
<tr>
<td><strong>Dist</strong></td>
<td>-0.0014 (-1.5183)</td>
<td>-0.0020 (-2.4749)</td>
<td>-0.0020 (-2.5739)</td>
</tr>
<tr>
<td><strong>Estac</strong></td>
<td>-0.0793 (-2.5796)</td>
<td>-0.0759 (-2.8309)</td>
<td>-0.0771 (-2.9821)</td>
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<tr>
<td><strong>Log(precio)</strong></td>
<td>0.0849 (2.8164)</td>
<td>0.0647 (2.4137)</td>
<td>0.04972 (1.8897)</td>
</tr>
<tr>
<td><strong>Estrag</strong></td>
<td>0.0612 (2.1791)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Plan</strong></td>
<td>0.0832 (3.5884)</td>
<td>0.0686 (3.0023)</td>
<td></td>
</tr>
<tr>
<td><strong>Frec</strong></td>
<td>0.0684 (2.8968)</td>
<td>0.0576 (2.4909)</td>
<td></td>
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<td><strong>F_cur</strong></td>
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<td>0.0480 (2.0051)</td>
</tr>
<tr>
<td><strong>F_otros</strong></td>
<td></td>
<td></td>
<td>0.0632 (1.6768)</td>
</tr>
<tr>
<td><strong>FM_cent</strong></td>
<td></td>
<td></td>
<td>0.0611 (2.5240)</td>
</tr>
<tr>
<td><strong>FM_emp</strong></td>
<td></td>
<td></td>
<td>0.0482</td>
</tr>
</tbody>
</table>

2 The explanatory variables are reported in Annex 2.
3 La variable endógena de estos modelos es la proporción de innovaciones totales de cada empresa. Los números entre paréntesis son los valores del estadístico t de Student.
As regards company specific characteristics, the following variables show a statistically significant positive relationship to technological positioning of the company: number of hotel beds per worker, whether or not the company had the distinctive Q seal of quality, number of stars of the hotel and seasonal capability. All variables were statistically significant at 95%, while the location was only significant at 90%. The “price” variable was transferred into logarithms to avoid problems of unit measurement, quantifying the price of the services offered by the hotel. Model 1 shows that the variable is positively significant.

As regards the technological strategy of the company the variables: “the company has a defined technological strategy” and “the company has a plan for implementing innovations” have a relevant positive significance with respect to their own technological position and development.

When comparing Model 3 with Model 1 it can be seen that statistically speaking the former is more significant. This suggests that the ensemble of variables set out in Model 3 is jointly more significant and thus introduces an additional explanatory value.

The estimation results indicate that the variables which refer to methods of financing innovations don’t statistically explain the amount of total innovations made by the company.

With regard to the acquisition of technologies, it can be shown, that only the variable which refers to its own technology is statistically significant, while the other two regimes of technology development, rented or acquired, are statistically not significant in terms of explaining technological development.

Also estimation results as regards a company’s information in technology, only the variable sources of information provided by Courses and Seminars to deal with new technologies show up as being statistically significant.

It is clearly shown by the model that training programmes set up by companies for its staff improve the technological positioning of the company significantly, particularly if they are set up and given to the staff by qualified personnel of the same company. This suggests that every company has a fundamental potential of human resources, which is the key to its development of innovations. The characteristics of management and the manager’s age and training have in the same way become explanations for innovation success.

For firms covering only (as opposed to all innovations) new technologies the results are similar to the ones obtained for the total of innovations. For innovations to be found only in the a production process, the variable quality of a service given by the company, the sources of information for technology and the training strategy no longer constitute explanatory factors. Finally, the amount of innovation adopted by management explained by any of the variables considered.

CONCLUSIONS
Innovation activities should be understood as a gradual process of improvement and perfection whereby the way in which new and necessary abilities for implementing innovations are acquired influence the speed of diffusion. In this way, learning is typically related with industrial organisation and specialisation problems because the increase of productivity which is potentially attainable can only be reached if there is a group of coherent relationships between innovation and existing technological structures. In this regard there also exist a set of social, legal, institutional and economical variables which must influence the speed of the diffusion process.

A conclusion for a quick and efficient way of making the most of innovation diffusion is the existence of technical investigation capacity to introduce improvements in innovation, with the purpose of solving the problems that could arise with the existing structures and carrying out a learning process that allows the maximum innovation technical innovation output. This part isn’t clear!

If tourism companies are to develop more profitable positions it is necessary for them to examine the company’s available technological potential in order to assess which NT should be considered and adopted similarly. It is equally important to evaluate the company’s competitive market position with respect to innovation activities.

Therefore, the goals to be pursued in R&D should be orientated not only towards developing technological strength but should also meet business goals by prioritising according to need. Under no circumstances must quality strategies be forgotten once the technological strategy of the tourism sector has been upon decided.

Tourism companies must aim to position themselves in Groups III and IV, and in order to achieve this, companies should make an effort to combine technological and quality priorities. This must undoubtedly be the future strategy to adopt by tourism companies.

Spanish hotel companies should think about their technological needs and invest in them without damaging the quality of the company, because in the end it is quality which guarantees long-term competitiveness.

This suggests to study the NT income-yield capacity and the associated process and development of the profit strategy of the company. For this to happen, it is important to establish analytical criteria such as the incorporation into the production processes of existing technologies and into the R & D marketplace.

In order to achieve a better technological position, it is important that business buy the appropriate technology rather than rent it from other business.

Innovation consists of carrying out a series of isolated new projects, but is also a business process directly linked to the strategy of the company, to its future competitiveness and to its quality strategy. To draw profits out of innovation, the company should demonstrate its commitment by assigning material and human resources. Taking this as a basis, the relationship between the education and training of staff and innovation has been studied, observing that these guarantee a higher level of innovation and a fast diffusion of technology.

The majority of tourism companies are aware of this fact, so they provide training to their workers because they consider that the training workers had received in the past is not usually suitable for the characteristics required in the implementation of innovations, particularly as regards information and communication technologies. Thus, it can be concluded that employers will participate more actively in training programmes as long as they can direct it towards specific, rather than general, training.

On the other hand, it was shown that, traditionally, the most relevant variables in technological change were the percentages of semi-skilled staff in relation to the total number of managerial staff, the manager’s qualification level, the collaboration of the company with training programs, and the existence and availability of experts in communication technologies in the company.

The education and training of workers guarantees a quick diffusion of technology and greater success in obtaining quality for the company.

The study has also analysed which types of technology spread quickest, e.g. those that are related to computing and the internet, while those that are related to their own production structure, such as sales outlets, yield management etc, have been much slower.
The more relevant variables in technological change are the percentage of intermediate controls on the total management team, the manager’s qualifications, the company’s co-operation in relation to training courses, the existence in the company of communication technology experts, the occupational courses carried out periodically since 1995, and the variable effort made by the company in the training process. Similarly it has also been demonstrated that companies working within an innovating environment tend to be innovative.
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Table 2. Innovations

**ICT:** The following have been considered as indicative of innovations in information and communication technology:

1. Computer (dichotomic variable which takes the value 1 if the firm has a computer and 0 if it does not)
2. Renewal of general software (dichotomic variable which takes the value 1 if the firm renews its general software and 0 if it does not)
3. Renewal of specific software (dichotomic variable which takes the value 1 if the firm renews its specific software and 0 if it does not)
4. Internet connection (dichotomic variable which takes the value 1 if the firm is connected to the Internet and 0 if it is not)
5. Offers Internet to clients (dichotomic variable which takes the value 1 if the firm offers Internet to clients and 0 if it does not)
6. Cable connection to the Net (dichotomic variable which takes the value 1 if the firm is connected to the Net by cable and 0 if it is not)
7. Intranet (dichotomic variable which takes the value 1 if the firm has intranet and 0 if it does not)
8. Videoconference (dichotomic variable which takes the value 1 if the firm has videoconference facilities and 0 if it does not)
9. Web page (dichotomic variable which takes the value 1 if the firm has a web page and 0 if it does not)
10. Uses eCommerce (dichotomic variable which takes the value 1 if the firm uses eCommerce and 0 if it does not)
11. Computer staff specialized in programming (dichotomic variable which takes the value 1 if the firm has computer staff specialised in programming and 0 if it does not)
12. Computer staff specialized in computerization (dichotomic variable which takes the value 1 if the firm has computer staff specialised in computerization and 0 if it does not)

**PP:** The following have been considered as indicative of innovations in the productive processes of firms or hotel establishments:

1. Photocell (dichotomic variable which takes the value 1 if the firm has photocell and 0 if it does not)
2. Electronic locks (dichotomic variable which takes the value 1 if the firm has electronic locking devices and 0 if it does not)
3. Yield Management Systems (dichotomic variable which takes the value 1 if the firm employs yield management systems and 0 if it does not)
4. Point of Sale Systems (dichotomic variable which takes the value 1 if the firm employs point of sale systems and 0 if it does not)

**MP:** The following have been considered as indicative of innovations in the management processes of firms or hotel establishments:

1. Advance Booking (dichotomic variable which takes the value 1 if the firm has advance booking facilities and 0 if it does not)
2. CRS or GDS booking facilities (dichotomic variable which takes the value 1 if the firm has CRS or GDS booking facilities and 0 if it does not)
3. Credit card (dichotomic variable which takes the value 1 if the firm provides credit card services and 0 if it does not)
4. Virtual cash (dichotomic variable which takes the value 1 if the firm provides virtual cash services and 0 if it does not)
5. Editourism (dichotomic variable which takes the value 1 if the firm provides Editourism services and 0 if it does not)

**TI:** total innovations includes innovations in ICT in the production process and in the management process of firms or hotel establishments.