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ISO 9001 AND ISO 14001 DIFFUSION: THE CASE OF SPAIN AND SERBIA*

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Abstract: *ISO 9001 and ISO 14001 certifications has grown spectacularly all over the world in recent years, even though a certain saturation has been detected in some countries. On the one hand this paper aims to analyze the world wide diffusion process of these two standards, using data provided by the ISO itself by a diffusion model based on the logistic curve, that fits quite well to explain the growth of certifications. On the other hand, the paper aims to analyze the case of Spain, one of the countries with a bigger ISO 9001 and ISO 14001 certification's intensity impact, as well as the case of Serbia, a country where ISO 9001 certification is growing more and more.*
Keywords: *ISO 9001, ISO 14001, Standardization, Diffusion.*

1. INTRODUCTION

During the past few years there has been a significant growth in the standards issued by agencies specialized in standardization in the economic field. This growth has largely been due to the marked process of economic globalization and integration that western economies have experienced over the last two decades (Mendel, 2001).

Standardization could be generically defined as that activity aimed at putting order into repetitive applications that arise in the field of industry, technology, science and the economy. In its beginnings, at the start of the 20th century, standardization arose to limit the anti-economic diversity of components, parts and supplies so as to favour their interchangeability, facilitating serial production and the repair and maintenance of products and services. In a global economy without standardization and the fruits of it – regulations, standards and technical specifications – exchanges would be exceeding difficult. Consequently, standardization fosters international trade thanks to the elimination of obstacles due to different national practices. Notwithstanding, these standards often form non-tariff barriers to international business relations as they are not truly global. As several authors have pointed out, while there are fewer and fewer tariff barriers, non-tariff barriers – technical standards and regulations which affect the requirements of products, services and, indirectly, production processes – take on greater importance.

At present there is a great number of national and international standards attempting to order and systematize – among other things – the implementation of business management systems in terms of very different functions and operating activities, such as quality improvement (ISO 9000, TS 16949, QS 9000, EAQF, VDA, etc), environmental management (ISO 14001, Ecoprofit, Ekoscan, etc), occupational hazard prevention (OHSAS 18001), corporate social responsibility (SA 8000, AA 1000 and the ISO 26000 draft standards), R+D activities (the Spanish UNE 166000 EX experimental standard), and human resources management (Investors in People). All of these standards included in the set of Management System Standards (MSS) are dealt with. However, it must be made clear that these MSS are not based on standards which refer to the attainment of a specific objective or result – that is to say, they are not result or performance standards, but rather standards which establish the need to systematize and formalize a whole series of business procedures related to the different fields of business management in a series of procedures.

From a global perspective, the success of disseminating all these management standards seems to be closely linked to the dynamics of the globalization process of Western economies and the main players in them – multinationals: if standardization originally came about in order to limit the anti-economic diversity of components, parts and supplies in an economic environment in which outsourcing and relocation of business activity prove to be strategic elements, it must nowadays promote a certain homogeneity in business management systems in order to favour such processes. Specialists in this field point out

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that in the absence of a regulating power of a global and public nature, the task of designing, implementing and enforcing standards, in areas in which such measures have traditionally been thought of as part of the regulation of public powers, is increasingly taken on by different regional or global institutions of a non-governmental nature (Brunsson and Jacobsson, 2000) .

All these standards employ very similar methodologies for their creation, structuring, implementation and third-party verification processes. Two series of standards issued by the International Organization for Standardization (ISO) stand out among them, due to their successful dissemination: the ISO 9000 series, related to the implementation of quality systems, and the ISO 14000 series, related to the implementation of environmental management systems, and at the same time the analytical objective of this article.

The ISO 9000 phenomenon has aroused great interest and has been extensively studied in academia. While the literature is not as extensive as that analyzing ISO 14000 implementation, research on the ISO 9000 can be found. Although the results of these studies are very diverse, it could generally be stated that external factors, especially the coercive pressure of customers, are very important motivators in the implementation of the standards referred to. Regarding the methods used in these studies, they are generally based on opinions obtained from surveys circulated among company environmental and quality managers, and thus reflect an inherent bias.

Recently, research focusing on the endogenous process of ISO 9000 dissemination has been carried out internationally, and the work of Saraiva and Duarte (2003) and Franceschini (2004) stand out. Now, in the academic literature known to us, only Professors Corbett and Kirsch (2001), in an extension of the research carried out by Vastag (2003) and Marimon *et al*. (2006), have analyzed the joint dissemination of ISO 14000 and ISO 9000. These studies are interesting not only due to their descriptive and predictive capacity regarding the dissemination process of these international standards per se, as highlighted by the authors, but also because they offer certain empirical evidence with regard to whether an analogy can be drawn between the dissemination process of these standards and the dissemination of innovations in general.

There is a crucial difference between the studies we have read and the present one. Those studies were done at a time when the number of certificates was growing year by year, with both standards in clear expansion, a situation in many countries that is very different from the present one. In fact, and as the ISO itself includes in its latest annual report analyzing the international dissemination of both standards, recent years have seen a certain drop in the number of certificates in several of the countries which had historically been leaders in this area.

The purpose of this paper, with its clearly exploratory and pilot content, is to analyze in detail the evolution of ISO 9001 and ISO 14000 certificates on an international level, in order to predict their future diffusion.

The data offered by ISO (2006) indicates that, as of December 2006, there were already 161 countries with ISO 9000-certified companies, and the number of certificates worldwide is at least 776,608. When ISO 14000 was published, 127,349 certificates had already been issued for ISO 9000. Like ISO 9000, ISO 14000 was also disseminated worldwide, although not yet with the same degree of success. With respect to the expansion of the ISO 14000 standard, the latest data available, indicate that 111,162 certificates have already been issued in a total of 138 countries.

It should also be specified that data supplied by ISO regarding the number of certifications worldwide is used in this research. It is very important that this data be viewed with some caution, as it may contain errors or aspects which need to be qualified. First, it should be taken into account that the current version of both standards allows single site certification, which would explain a huge reduction if multinational firms apply this model, although the details provided by ISO do not place importance on this. Second, the ISO organization itself acknowledges the fact there are some errors in its data, which are compiled through organizations from different areas in each specific country in a different way. That is why the reduction in the number of certifications analyzed in this article is not necessarily due only to companies which have stopped being certified, but may also be due to other reasons which are difficult to contrast in any research work.

Having said this and analyzing the data given by ISO itself in more detail, it is easy to see how the situation is not very optimistic. Making a comparison using the latest data, and only considering the 13 countries with the greatest number of certificates – which reflect more than 70% of all certificates worldwide – we obtain the data in Table I. The nature of the analyses carried out from country to country makes it very difficult to work with a large number of countries, as well as making it quite possibly of little relevance. That is why a decision has been made to only focus, throughout the research, on the 13 leading countries in ISO certifications, from wich we will

select Spain as one of the countries in the EU-27 were both ISO 9001 and ISO 14001 certification has grown sharply in the last ten years, and Serbia, a country were ISO 9001 and ISO 14001 certification is still in another stage of growth.

Table II: Number of ISO 14000 and ISO 9000 certificates in the 13 countries with the highest number of certificates and Serbia-Montenegro in 2002, 2003, 2004 and 2005

	ISO 9000 (2002)	**ISO 9000 (2003)**	**ISO 9000 (2004)**	**ISO 9000 (2005)**	**ISO 14001 (2002)**	**ISO 14001 (2003)**	**ISO 14001 (2004)**	**ISO 14001 (2005)**
China	75,755	96,715	132,926	143,823	2,803	5,064	8,862	12,683
Italy	61,212	64,120	84,485	98,028	2,153	3,066	4,785	7,080
U.K.	60,960	49,151	50,884	45,612	2,917	5,460	6,253	6,055
USA	38,927	41,571	37,285	44,270	2,620	3,553	4,759	5,061
Germany	35,802	24,889	26,654	39,816	3,700	4,144	4,320	4,440
Japan	33,964	55,916	48,989	53,771	10,620	13,416	19,584	23,466
Spain	28,690	33,125	40,972	47,445	3,228	4,860	6,473	8,620
Serbia-Montenegro	314	405	696	1,209	2	12	46	77
Australia	27,135	19,975	17,365	16,922	1,485	1,250	1,898	1,778
France	19,870	18,007	27,101	24,441	1,467	2,344	2,955	3,289
Republic of Korea	14,520	12,846	12,416	14,033	1,065	1,495	2,609	4,955
Netherlands	13,198	10,309	6,402	9,160	1,073	1,162	1,150	1,107
Canada	12,371	11,759	9,286	12,503	1,064	1,274	1,492	1,636
Switzerland	10,299	9,063	11,549	12,413	1,052	1,155	1,348	1,561
Total world	*561,747*	*567,985*	*670,399*	*776,608*	*49,449*	*66,070*	*90,569*	*111,162*

Source: Put together by the authors from the ISO surveys of ISO 9000 and ISO 14000 Certifications.
Note: data for ISO 9000 includes ISO 9001, ISO 9002, ISO 9003 and ISO 9001:2000 certificates.

It is important to point out different aspects in the previous table: while there are some countries dealing with a declining number of ISO 9000 certificates (the United Kingdom and Australia), that is compensated on a worldwide scale by strong growth of China, Italy, Japan and Spain. Thus, although the number of certificates is increasing globally, the situation is worrisome, since various economically significant countries have already begun to experience a trend towards decertification. On the other hand, such behaviour is not detected with the ISO 14000: there continues to be modest growth in the great majority of countries, with the exception of China, where the growth is very high. As observed in Marimon *et al*. (2006), this seems normal, since the implementation of the standard in question has always taken place under the aegis of its famous predecessor.

In order to compare the number of certifications existing in each country, while taking into account the relative importance of the economies of those countries, a relevant analysis should involve studying certification intensity using certain rates created for this study. This intensity of certification in ISO 9000 (r9) and ISO 14000 (r14) is the relationship between the number of certificates and an indicator of the GDP of each country. This indicator is the simple average of the GDP of the four years expressed in 1.00 E+09 current $US. In this way, r19 shows the number of ISO 9000 certifications for each 1.00 E+09 $US of average GDP for these four years. Similarly r14 shows the intensity of ISO 14001. These indexes allow comparisons between countries whose absolute certification numbers are quite different, but may show a similar behaviour toward these standards. To only provide an example, as this will be analyzed later, these indexes show that Spain and China are in the same cluster, even though China has almost four times as many ISO 9000 certifications as Spain. Hence, this indicator does not make economic sense; it is used as a constant deflator over the four years to avoid the fluctuations between $US and the currency of each country. Without doubt, it would be even more interesting to calculate this intensity, not in accordance with contribution to GDP, but rather, for example, in accordance with the number of plants or industrial companies in each of the countries. However, the real difficulties inherent in being able to avail of appropriate data make it necessary to use the indicator mentioned.

Analyzing the intensity of certification using the aforementioned rates, as noted in the case of ISO 9000 certification in Table II, a significant

decertification in some analyzed countries may also be observed, particularly in places like Australia, the United Kingdom or the Netherlands. Conversely, the situation is very different in the case of the ISO 14000 standard, in which all the countries analyzed evidence growth in this rate. This growth may even be deemed spectacular in countries such as China, the Republic of Korea, Italy, France, Spain, and Serbia-Montenegro where the rate has sharply increased in the last years.

Table II: ISO 14000 and ISO 9000 certification index in the 13 countries with the highest number of certificates and Serbia-Montenegro in 2002, 2003, 2004 and 2005

	r9 (ISO 9000 intensity)				r14 (ISO 14000 intensity)			
	2002	**2003**	**2004**	**2005**	**2002**	**2003**	**2004**	**2005**
China	46,12	58,87	80,92	87,55	1,71	3,08	5,39	7,72
Italy	40,21	42,12	55,50	64,39	1,41	2,01	3,14	4,65
United Kingdom	31,67	25,54	26,44	23,70	1,52	2,84	3,25	3,15
USA	3,43	3,66	3,28	3,90	0,23	0,31	0,42	0,45
Germany	14,47	10,06	10,77	16,09	1,50	1,67	1,75	1,79
Japan	7,79	12,83	11,24	12,34	2,44	3,08	4,49	5,38
Spain	31,79	36,70	45,40	52,57	3,58	5,39	7,17	9,55
Serbia-Montenegro	14,50	18,71	32,15	55,84	0,09	0,55	2,12	3,56
Australia	47,29	34,81	30,26	29,49	2,59	2,18	3,31	3,10
France	10,85	9,83	14,80	13,35	0,80	1,28	1,61	1,80
Republic of Korea	22,15	19,60	18,94	21,41	1,62	2,28	3,98	7,56
Netherlands	24,77	19,35	12,01	17,19	2,01	2,18	2,16	2,08
Canada	13,47	12,80	10,11	13,61	1,16	1,39	1,62	1,78
Switzerland	31,18	27,44	34,97	37,58	3,19	3,50	4,08	4,73

Source: Put together by the authors from ISO and data from OCDE and IMF. Note: Data for Serbia-Montenegro from the IMF's World Economic Outlook and EconStats.

2. DIFFUSION MODELS

The literature related to dissemination of the different management tools and systems is very extensive, since this is a research topic that has enjoyed great interest among academics of different fields (the synthesis reflected in Rogers (1995) is particularly interesting). Specifically, the literature is very extensive on studies dealing with the dissemination of innovative technologies, which can also be applied in some way to management innovations; i.e. to innovations in general, as Teece (1980) does, demonstrating that the models of technological innovation are not limited to tangible products. From these studies, it may be roughly deduced that the accumulative adoption of innovations over time follows an S-shaped or sigmoid curve reflecting the fact that few members of a social system adopt an innovation in practice during its first stages, and that the rate with which innovations are adopted rises until the process reaches its saturation point, when the growth rate falls anew. Stoneman (1995) claims that this model usually explains well the phenomena of diffusion in the field of new technologies.

Some studies tackling questions similar to those formulated in this study, however incipient, have already been carried out and reported in the specialist academic literature. With regard to the development of the ISO 14000 and ISO 9000 standards, Corbett and Kirsch (2000) propose a regression model that explains the number of ISO 14000 certificates in a given country on the basis of its exporting capacity, its degree of commitment to the environment and the number of ISO 9000 certificates issued in that country. However, it must be taken into account that this interesting study is static in nature: it does not analyze the development of both standards, the ISO 14000 and the ISO 9000, over time. In the study carried out, the authors conclude that the number of ISO 9000 certificates in a given country is one of the factors explaining the number of ISO 14000 certificates issued in the same country; however, they neither specify how such a dissemination occurs, nor do they analyze the sectorial factor, which, as they themselves state in the conclusions of their research, would be an interesting analysis.

On the other hand, Franceschini *et al*. (2004) have established that the logistic curve explains the dissemination of the ISO 9000 well. As reflected in mathematical literature, the logistic curve model was applied for the first time by the Belgian mathematician Verhulst during the 19th century in the field of biology to account for the growth of a

species. According to this model, a growth rate is at its maximum at the start, when there are very few individuals in the species and there is scarce competition for limited resources, and becomes zero once a certain size is reached. This is the size of saturation that the available resources permit. The model responds to the following expression:

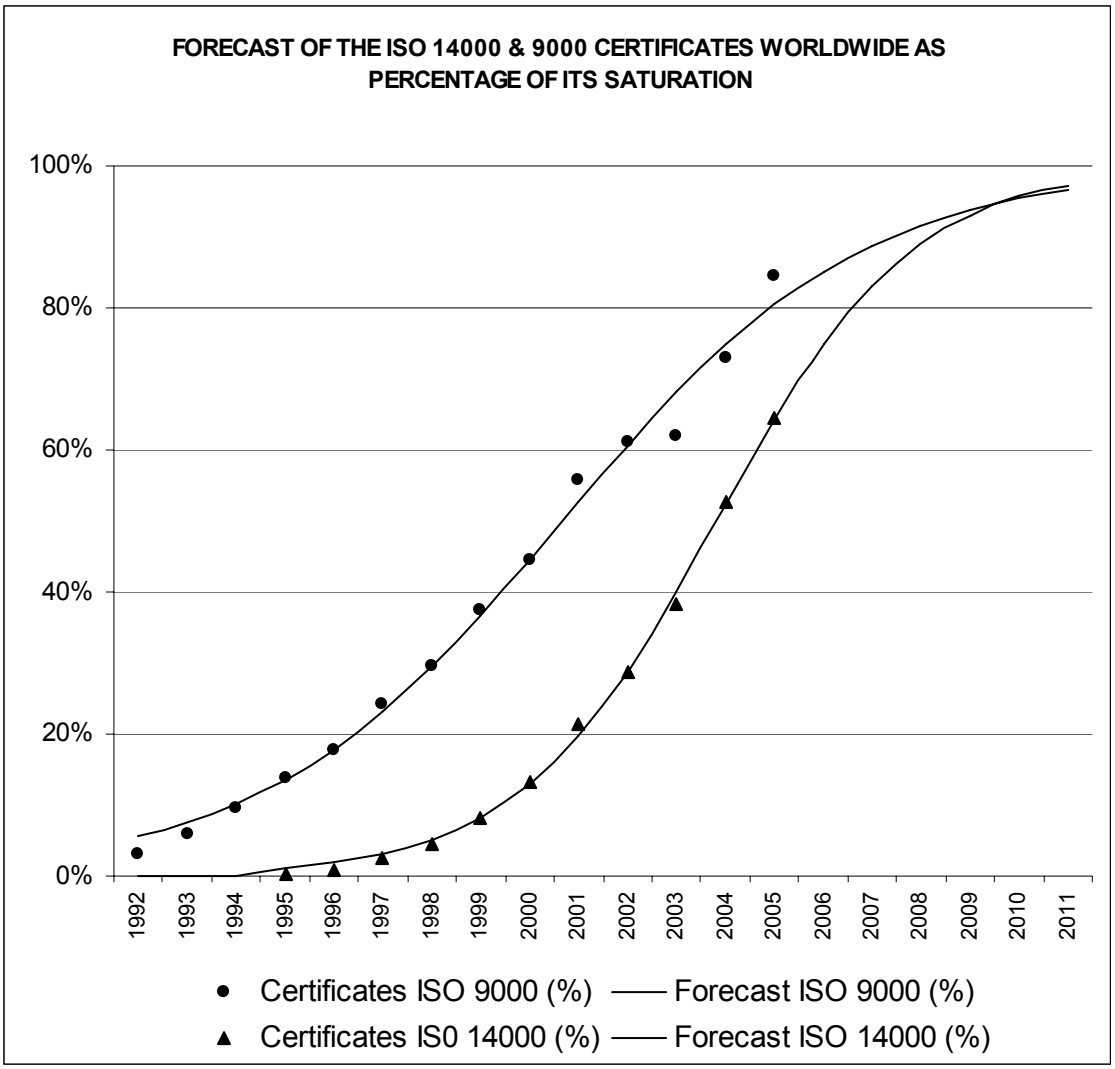
$$N = \frac{N_0 K}{(K - N_0)e^{-r_0 t} + N_0}$$

in which N represents the number of certificates, a function of time; N_0 represents the number of certificates at the starting point; and K is the maximum level that may be reached, the saturation level. The initial growth rate is determined by r_0.

3. FORECAST OF THE EVOLUTION OF ISO 9001 AND ISO 14001 CERTIFICATION FOR SPAIN AND SERBIA

For the worldwide case, in Figure I it may be observed how the logistic models suits the current certification data perfectly, with a fit of more than 99% for r squared in both curves. At present, we are at 64.6% of the saturation level for the ISO 14000 and 84.6% for the ISO 9000, despite, as Marimon *et al*. (2006) point out, ISO 14000 certification is experiencing rather faster growth than the ISO 9000. Considering 95% as a possible saturation point, the forecast according to this model is to arrive at a maximum of 160,000 ISO 14000 certificates and some 870,000 ISO 9000 certificates worldwide.

Figure I: Forecast of the ISO 14000 and ISO 9000 certificates worldwide as a percentage of their saturation



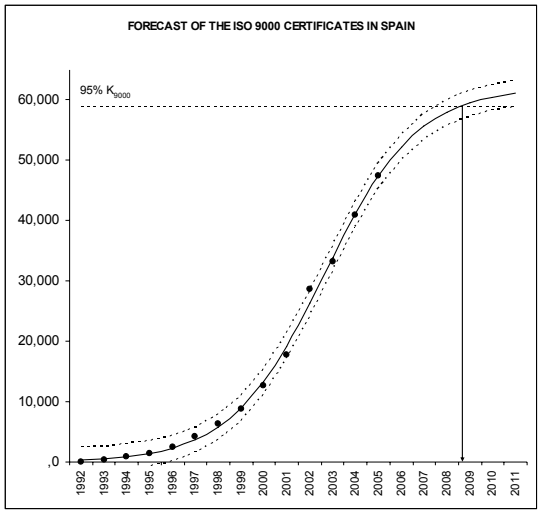
Forecast of ISO certificates worldwide considering the logistic curve.

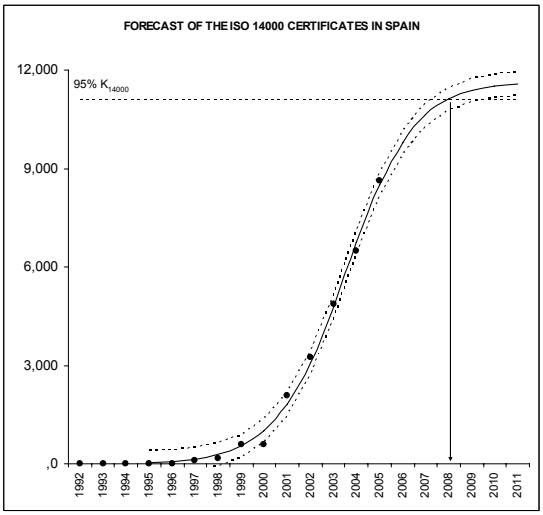
	ISO 14000		ISO 9000	
	DF	**Sum Sq**	**DF**	**Sum Sq**
Regression	3	29504803542.73	3	2407501349672
Residual	7	25727264.27186	11	6761130320.651
Uncorrected Total	10	29530530807	14	2414262479993
(Corrected total)	9	14611876279.64	13	772653744844.4
R squared	.998		.991	

	Value	LL	UL	Value	LL	UL
N_0	2063.40	1265.79	2861.013	50818.44	32629.40	69007.49
K	172209.19	137517.04	206901.35	917655.01	749629.52	1085680.51
r_0	0.5003	0.4327	0.5679	0.3271	0.2601	0.3940

To analyze the relationship between ISO 9000 and ISO 14000 certifications we will know focus on the case of two countries that are in a very different position in the stage of evolution: Spain and Serbia.

Figure II: Forecast of ISO 14000 and ISO 9000 certifications applying the logistic curve in Spain





Forecast of ISO certificates in Spain considering the logistic curve.

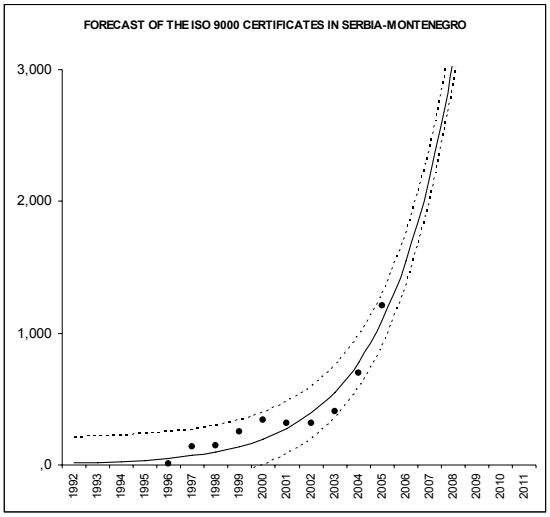
	ISO 14000		ISO 9000	
	DF	**Sum Sq**	**DF**	**Sum Sq**
Regression	3	5930017.17	3	6457414208.54
Residual	8	6214.83	11	10187810.45
Uncorrected Total	11	5936232	14	6467602019
(Corrected total)	10	2550632	13	3459985618.93
R squared	.996		.997	

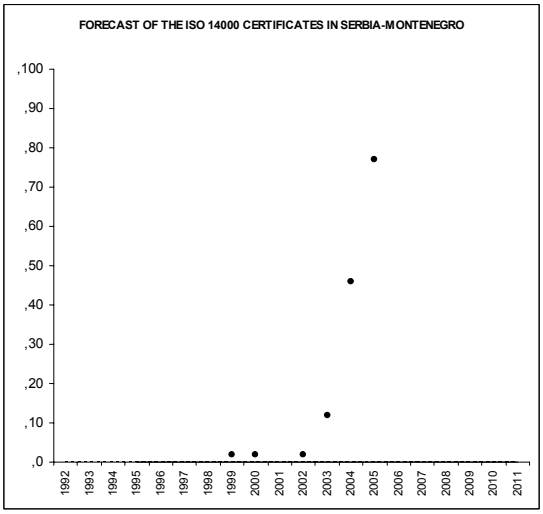
	Value	LL	UL	Value	LL	UL
N_0	38.48	1.94	75.01	327.15	142.34	511.97
K	11668.31	8883.42	14453.20	62029.35	53045.29	71013.41
r_0	0.6695	0.5253	0.8136	0.4932	0.4237	0.5627

LL: Lower limit of the 95% confidence interval (the left dotted lines in the figures).
UL: Upper limit of the 95% confidence interval (the right dotted lines in the figures).

Spain, as it has been stated before, is one of the countries where ISO 9000 and ISO 14001 has had a great impact on an international level. In Figure II it may be observed that the logistic models fits well in the case of Spain for both ISO 9001 and ISO 14001 certification. Spain seems to be in an expansion stage, but close to maturity, if we analyze the parameters of the logistic curve.

Figure II: Forecast of ISO 9000 certifications applying the logistic curve in Serbia-Montenegro





	ISO 9000	
	DF	**Sum Sq**
Regression	3	2437636,851
Residual	7	90087,149
Uncorrected Total	10	2527724,000
(Corrected total)	9	1065426,400
R squared	.915	

	Value	**LL**	**UL**
N_0	12,785	-41,302	66,872
K	10,337 * 10^9	-223741045,7 * 10^9	223741066,4 * 10^9
r_0	,343	-,183	,868

In the case of Serbia (Figure III), we have just forecasted the dissemination of ISO 9001 certification, since the we have very limited data for ISO 14001 certification. For the case of ISO 9001 certification we also have had some problems in order to gather the data for the analysis. As it In Figure III it may be observed that the logistic models doesn't fit very well for the case of Serbia, but it seems clear that Serbia is in an early stage of growth in the diffusion process of certifications.

4. CONCLUSIONS AND FINAL REFLECTIONS

Despite the general growth worldwide of ISO 9001 and ISO 14001 certifications, it is possible to define three types of country in terms of an expansion in both standards: the countries evidencing "expansionist", "mature" and "retrocessive" behaviours. Included in the first case would be those countries evidencing a constant growth in the number of certifications according to both standards – growth which may be easily modelled by logistic curves. China, some countries of Central and Eastern Europe (e.g. Bulgary, Hungary, Estonia) that already has joined the EU and other European countries, as Serbia, that are candidates to join the Union in a future ampliation, are the most representative countries in this group.

On the other hand, there are countries evidencing "mature" behaviour. Would be those in which the number of ISO 9000 certifications has reached 95% expansion, according to the model used, and a process starts involving a decrease in certified companies which is difficult to model, whereas the number of certified companies according to the ISO 14001 standard continues to grow. Lastly, those countries evidencing "retrocessive"

behaviour would be included in the group in which the level of certifications decreases for both standards (e.g. Australia).

But, why could ISO 9001 and ISO 14001 certification decline? The first possible argument is related to the possible loss of appeal of the certifications, due to the fact that the intrinsic value of the certificates supporting such implementation decreases as the total number of certificates increases. Indeed, we understand that many companies have embarked on the process of implementation and certification of ISO 9000 standards motivated by the competitive advantage and the differentiation of image resulting from having the certificate. It seems obvious that the intrinsic value of the certificate is not constant, but rather tends to decrease in an environment in which possessing the aforementioned certificates does not prove to be a distinguishing factor for companies. It is very possible that the same occurred with the ISO 14001 standard. Linked to this fact, it would be interesting to analyze the hypothesis that a competition factor is involved in the dissemination of MSS such as ISO 9000 and ISO 14000 of business management general models, and other models of excellence such as EFQM, Malcom Baldrige and the Deming model. All this means that as companies steadily implement, take on and certify a certain standard, it makes sense to certify for a period of time, but gradually this certification will lose its importance, and be discontinued. Of course, this does not mean that the standard is not used, but rather that it is simply not certified. From then on, the company will focus its attention on other standards or models which it will probably be more interested in certifying, either to show to its customers and competitors or to ensure its proper implementation. On the other hand, and as authors such as Delmas (2002) and Potoski and Prakash (2004) have stated, it is clear that the political and regulatory context of each country and, in particular, the prescriptive role of public administrations plays a fundamental role in extending these MSS: direct or indirect grants for the implementation and certification of these systems may play a major role in the growth of certificates in a specific country, but also in the decertification process (as is the case of Australia in which very particular behaviour is detected, probably for these reasons). We understand that this is an issue that should be contrasted in subsequent studies.

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