

## ISO 9000—a marketing tool for U.S. agribusiness

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### Abstract

The relevance of the ISO 9000 series of quality management systems (QMS) for U.S. agribusiness is analyzed. Certified firms from several industries were surveyed to determine their before (*ex ante*) and after (*ex post*) perspectives of the QMS. Results for the agribusiness subsample are compared to those for firms from other industries to determine if they behave differently. Anticipated marketing advantages (increasing market share and providing access to new markets) of the QMS were critical factors that encouraged the pursuit of the certificate. The average cost to attain certification was \$101,400 and to maintain certification was an additional \$26,500 per year. © 2001 Elsevier Science Inc. All rights reserved.

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### 1. Introduction

The ISO 9000 series of quality management systems (QMS) is rapidly becoming an important component of the production and marketing plans of firms. The ISO 9000 series is a group of three QMS (9001, 9002, and 9003) designed to provide a generic structure that guides the quality policy, objectives, and responsibilities of a firm. An ISO 9000 certificate is awarded by a registration company upon completion of a series of external audits of the QMS. Thus, ISO 9000 provides an example of both a third party certification program and an holistic QMS. Each of these elements is becoming increasingly important marketing tools for agribusiness firms attempting to deliver quality-differentiated products in a consistent manner.

Currently, the U.S. lags behind certain nations within trading blocs such as the European Union (EU) in terms of adopting ISO 9000 standards as minimal evidence of quality

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management. Similarly, agribusiness firms, in the U.S., and elsewhere, have been slow to become ISO 9000 certified. In this study ISO 9000 certified U.S. firms are investigated to ascertain their level of satisfaction with the QMS, reasons for attaining certification, and perceptions of the impact ISO 9000 has had on firm performance, and marketing relationships with customers and suppliers.

Concerns over the applicability of ISO 9000 QMS to U.S. agribusinesses, uncertainty over the costs and benefits of the series, and the interaction of this particular third party certification process with other sets of controls [e.g., those targeting food safety attributes such as Hazard Analysis Critical Control Point (HACCP)-based QMS] have all been raised. This paper provides early evidence of the impacts of ISO 9000 QMS thereby addressing these concerns.

## 2. Background

ISO 9000 developed out of the British BS 5750 quality standards, being adapted for wider use in 1987 with the publication of its first edition. The series is managed by the International Organization for Standardization, a nongovernmental body made up of national standard setting bodies from some 133 countries. It attempts to harmonize voluntary industrial standards to facilitate international trade. However, the member bodies need not be and often are not government agencies. The U.S., for example, is represented by the American National Standards Institute and not the National Institute of Standards and Technology, the standard setting division of the U.S. Department of Commerce (Hooker and Caswell, 1999).

Certification to a particular ISO 9000 standard (either 9001, 9002, or 9003 with progressively narrower requirements) demonstrates a firms' quality planning, control, assurance, and improvement systems conform to an internationally agreed format. The ISO 9000 framework is built on twenty clauses or requirements, broad areas that impact all these areas of quality management (see Table 1). ISO 9001 is the most complete option covering all 20 clauses. ISO 9002 excludes 4.4 (design control) and is thus considered best suited to food processing facilities without research and development divisions. ISO 9003 is the least restrictive system, intended for operations that demonstrate conformance only via final inspection and testing and is recommended for commodity suppliers.

Research relating to agribusiness and ISO 9000 certification is very limited. For example, Bredahl, Holleran, and Zaibet (1994) provide a descriptive analysis of ISO 9000 in the U.K. food sector. Holleran and Bredahl (1997) found that in the U.K. the standard tended to be adopted in areas of the food sector where transaction costs were high (e.g., the soft drink and alcohol sectors). Zaibet and Bredahl (1997) suggested that in the U.K. meat sector (1) ISO 9000 certification could soon become a common business practice, (2) the cost of certification did not represent a significant constraint to adoption of the QMS, and (3) cost shifting due to ISO 9000 at the input-supplier level generated gains to both beef producers and consumers.

## 3. Data collection

The target population for the study consisted of ISO 9000 certified firms in the United States. A list of these certified firms was obtained from a well-established ISO 9000

Table 1  
ISO 9001 requirements

Clause	Title and description
4.1	<i>Management responsibility</i> : Defines the firm's quality policy, organization, and management review. This step ties that part of management with 'executive responsibility' to the quality system.
4.2	<i>Quality system</i> : Defined as the combination of organizational structure, procedures, process and resources, the quality system must be fully documented and maintained to meet all 'specified requirements'. This step involves the preparation of a quality manual.
4.3	<i>Contract review</i> : Addresses the capabilities of the firm to meet its contractual requirements.
4.4	<i>Design control</i> : Reviews the design of the product to ensure that all specified requirements can be met. This step follows each stage of the process through design review, verification, validation, and changes.
4.5	<i>Document and data control</i> : Linking with other clauses, this is the commitment the firm makes to maintain all documents and data and guarantee these records reflect up-to-date practices.
4.6	<i>Purchasing</i> : Sets-up checks that all products purchased from subcontractors conform to their specified requirements.
4.7	<i>Control of customer-supplied product</i> : Firms that incorporate customer-supplied ingredients or packaging materials into their end-products should establish and maintain documented procedures for the verification, storage, and maintenance of products.
4.8	<i>Product identification and traceability</i> : A system that follows the product through each stage of production, delivery, and installation should be implemented. This 'trace-back' capability is essential for product recalls.
4.9	<i>Process control</i> : That all aspects of the production process (e.g., buildings, plant, equipment, personnel, etc.) must be carried out under controlled conditions. Further "where the results of processes cannot be fully verified by subsequent inspection and testing of the product and where, for example, processing deficiencies may become apparent only after the product is in use, the processes shall be carried out by qualified operators and/or shall require continuous monitoring and control of process parameters to ensure that the specified requirements are met (ISO 9001 1994, p. 6)."
4.10	<i>Inspection and testing</i> : Procedures to verify that the specific requirements of the inputs, intermediate, and final product are being met should be initiated.
4.11	<i>Control of inspection, measuring, and test equipment</i> : Those instruments required to comply with 4.10 should be periodically calibrated.
4.12	<i>Inspection and test status</i> : Some system of identification of the product that indicates if it is in compliance with the tests performed must be in place.
4.13	<i>Control of nonconforming product</i> : This is then followed-up with an assurance that nonconforming product is not inadvertently used (such may be reworked and then reinspected depending upon the details of the quality system).
4.14	<i>Corrective and preventative action</i> : There must be an effective system that implements both corrective and preventative action when required.
4.15	<i>Handling, storage, packaging, preservation, and delivery</i> : The quality of the product should be maintained during the post-production stages.
4.16	<i>Control of quality records</i> : All quality records should be readily available.
4.17	<i>Internal quality audits</i> : The quality system should undergo periodic internal reviews to determine its effectiveness.

(continued on next page)

Table 1 (continued)

Clause	Title and description
4.18	<i>Training:</i> Training needs should be identified and addressed to ensure qualified personnel are performing those activities that affect the quality of the product.
4.19	<i>Servicing:</i> Although unlikely to be appropriate for the agri-food industry, provisions for compliance with any after sales servicing requirements are included.
4.20	<i>Statistical techniques:</i> When statistical techniques are required to establish, control or verify the process capability or product attributes they should be documented.

Source: ISO (1996).

registration company. This list contained the name, address, and telephone number of 640 ISO 9000 certified firms. Cost considerations precluded surveying all firms. Alternatively, a systematic survey design was used to select a sample of 325 firms. Each firm was contacted by telephone, briefed with respect to the purpose of the survey, and asked if they would be willing to participate. If willing, the firm was (depending on their preference) sent a questionnaire by mail or fax. Firms were given 3 weeks to reply. Those that had not returned the survey within the allotted time were sent a reminder via fax or telephone. Due to cost considerations it was not possible to perform any follow up analysis on questionnaire nonresponses.

The survey instrument was developed after a comprehensive review of the literature, including questionnaires that had been used to determine the impacts of ISO 9000 and ISO 14000 (a series of environmental management systems). The instrument was screened for technical accuracy, clarity, and natural flow of the order of questions. The final instrument included 48 questions divided into five sections; (1) ISO 9000 certification status, (2) ISO 9000 and firm performance, (3) ISO 9000 and trade, (4) ISO 14000 certification status, and (5) firm profile.

From the 325 firms that agreed to participate in the survey, 197 completed questionnaires were returned, yielding a response rate of 61%. Missing or invalid information led to the deletion of 8 questionnaires and an overall response rate of 58%. The firms represented various segments of the supply chain with a diverse range of organizational structures and firm sizes. The 197 completed questionnaires were divided into responses coming from a broadly defined group of 'agribusiness' firms and firms in other industries. This process led to an agribusiness subsample of 11 completed questionnaires. These agribusiness firms include equipment and input supply companies predominantly associated with food production and processing clients, manufacturers and processors of food ingredients and value added corn, dairy and vegetable products, as well as nutritional supplements.

#### 4. Findings related to the agribusiness industry

##### 4.1. Profiles of agribusiness firms

The nature of the agribusiness goods was divided over the following categories; 3 of the respondents viewed their products as consumer goods, 9 as manufactured goods, and 1 as

some other type (the percentages sum up to more than 100 due to double counting). Further, 2 of the respondents reported their products as inputs, 4 as intermediate goods, and 5 as final products. It was also reported that 3 perceived their customers as being of medium size and 8 thought their customers were large within the industry. None of the respondents thought their customers were small. The fact that a majority of the certified agribusiness firms seem to be catering to larger customers may help explain part of the motivation of these U.S.-based suppliers to pursue the ISO 9000 QMS. Larger companies, especially food retailers in Europe (the agribusiness firms' direct customers) are encouraging their suppliers to seek ISO certification to help economize on their external (i.e., input-based) audit costs. ISO 9000 certification provides evidence of the QMS in place allowing large companies (i.e., customers) to assume that their product specifications will be met, and thereby minimizing the cost of internal and external audits.

#### *4.2. Certification status*

Only 4 of the agribusiness firms were certified to ISO 9001 and 7 to ISO 9002. This result may be explained by the lack of research or design components in the production processes of these latter plants. Similar results were found for the U.K. (Holleran and Bredahl, 1997). The average time for agribusiness firms to reach certification was 18 months. On average agribusiness firms had been certified for 31.5 months.

Regarding the organizational structure of the firms, 7 of the respondents stated that their firm was affiliated with a parent company, with 6 of these 7 firms having affiliates that were also certified to the ISO 9000 series. This result may be expected because the initiative to develop QMS such as ISO 9000 certification, which is plant based, often comes from a central office. Indeed such involvement of top management is stressed as a crucial part of the certification process. The decision to seek certification has to be backed up with allocated resources from the highest levels of management for the process to be a success (Wenmoth and Dobbin, 1994; Ho, 1994). In the case of those agribusiness firms surveyed, the decision to become certified was generated internally (within the firm) in all cases, although 6 firms stated that external forces like customer requirements also played a role in the decision.

#### *4.3. ISO 9000 costs and benefits*

The balance between the costs and benefits of ISO 9000 certification is one of the most uncertain aspects of the QMS. The average cost (per plant) of becoming certified was \$101,400 with the maintenance of the certification status costing \$26,500 per year (these cost values are the means for 5 of the agribusiness plants that reported dollar amounts). These costs are actually lower than those reported by the other firms (\$146,800 for attaining and \$32,400 to maintain). When asked to compare the costs versus the benefits, 9 of the respondents regarded the costs of becoming certified as low or moderate whereas only 2 regarded them as excessive. In the same manner, all respondents thought that the costs of maintaining certification were low or moderate and none regarded these costs as excessive.

To measure if the respondents attached any implicit value to the ISO 9000 certificate, the participants were asked if they were using their ISO 9000 status to promote their firm in any

way. Out of the total, 8 agreed that they were. Among others, the most common ways of using this status included printing the ISO logo on the firm's letterhead and brochures, and in the firm's presentations.

The ISO series of standards can have an impact on several areas of a firm's everyday activities. Because of this, the respondents were asked to rank the impact of ISO certification on the overall performance of the firm. They were given a scale from 1 (very bad) to 6 (very good). The average score given by the respondents was 4.5 with no response lower than 3. This suggests that there is a reasonably high level of satisfaction with ISO certification among these agribusiness firms. In this way any costs accrued during the ISO 9000 certification process and its maintenance seem to be offset by the benefits.

#### *4.4. ISO certification and its effects on trade*

The international marketing aspects of ISO 9000 certification have been regarded as one of the most important reasons to seek certification. This fact is demonstrated by the export focus of the agribusiness firms with 10 selling their goods abroad. Because an 'encouragement' to attain, and sometimes even a requirement of, ISO 9000 certification of their suppliers is stronger among European customers (e.g., wholesale importers), as compared to their North American counterparts, it was anticipated that such an export orientation would be common in the subsample. Indeed, the main destination for these exported goods was Europe with 7 of the firms trading with that continent. Asian and Latin American countries were also mentioned. When asked about exports after certification, 5 of the respondents stated their export levels remained the same whereas 3 said they increased. These figures could be indicative of the necessity of some firms to obtain certification simply to maintain their European customers.

The respondents were asked if they thought that more European importers were going to demand their suppliers abroad be ISO 9000 certified in the future. All of the respondents agreed. Furthermore, the survey asked if the ISO 9000 series was likely to become common practice to access the European market, and 9 thought this to be the case. It is clear from these results that the European trade bloc and its adherence to the ISO 9000 series has had an influence on its adoption by U.S. agribusiness firms.

#### *4.5. Perceptions of the certificate*

The perceptions of agribusiness firms regarding the future of the ISO 9000 series were also surveyed. 7 of the participants felt that there was a trend among the agribusiness industry towards becoming certified. Interestingly, 7 stated that ISO certification was going to lose its competitive advantage in the future due to general compliance, whereas 8 stated that the ISO series was going to become a minimal standard for the industry in the future. However, only 4 thought that ISO certification was going to become obsolete due to the emergence of other QMS. From these results it can be inferred that most of the competitive advantage gains that encourage many firms to seek certification will diminish as time passes. Early adopters therefore have much to gain. Further, to maintain a competitive advantage, innovators in the

Table 2  
Comparison of arguments for seeking ISO 9000 certification

Elements of Comparison	Agribusiness		Other Industries		<i>t</i> -test <sup>a</sup>	M-W-W <sup>b</sup>
	Mean	SD	Mean	SD	<i>p</i> -value	<i>p</i> -value
To comply with regulatory requirement	0.182	0.405	0.343	0.629	0.240	0.504
To reduce the firm's liability	0.364	0.505	0.242	0.502	0.452	0.267
Provides a marketing/competitive advantage	1.636	0.674	1.522	0.613	0.596	0.436
Reduction of costs	1.273	0.647	1.017	0.685	0.230	0.230
Customer requirement	1.000	0.775	1.270	0.748	0.285	0.240
Supplier requirement	0.182	0.405	0.303	0.571	0.365	0.577
Makes firm more profitable	1.091	0.539	1.101	0.752	0.954	0.896
Increases the firm's market share	1.364	0.674	1.208	0.726	0.474	0.513
Turns firm into a leader among competitors	1.545	0.522	1.652	0.584	0.528	0.345
Provides access to other markets	1.455	0.522	1.275	0.765	0.304	0.579

<sup>a</sup>Un-paired *t*-test (2 tailed) of means (heteroscedastic).

<sup>b</sup>Mann–Whitney–Wilcoxon rank sum test (2 tailed) of medians (adjusted for ties).

Average score: 0 for Not Important, 1 for Somewhat Important, 2 for Very Important.

agribusiness industry may turn to other QMS such as HACCP. For now though it can be said that ISO 9000 certification enhances the image of a firm's product.

## 5. Comparison with other industries

The responses of the agribusinesses subsample were compared to those of firms in other industries to determine if U.S. agribusinesses are experiencing different impacts after the adoption of ISO 9000 QMS. If similar, the concerns of the agribusiness community over the applicability of the QMS may prove unfounded. Two simple tests comparing the responses were employed with the results reported in Tables 2–5. Each test had a null hypothesis that the samples were drawn from the same population, with the alternative hypothesis being that the samples are drawn from different populations. The first test, is an un-paired two-tailed heteroscedastic *t* test of the means over the various categories considered. The second is a nonparametric statistical technique—the Mann–Whitney–Wilcoxon rank sum test of the medians.<sup>1</sup> The test statistic was adjusted for ties, an issue given the small number of categorical answers available to each survey question. Each of the sets of results is discussed in detail below.

### 5.1. Reasons for seeking certification

Respondents were queried about the factors considered as they sought ISO 9000 certification (i.e., *ex ante*). Table 2 summarizes the answers. The top reasons for seeking certification were that ISO 9000 would *provide a marketing/competitive advantage*, *turn the firm into a leader among its competitors*, *provide access to other markets* and *increase the firm's market share*. Also mentioned were that certification would reduce the firm's costs, make the

Table 3  
Comparison of arguments made against ISO 9000 before certification

Elements of Comparison	Agribusiness		Other Industries		<i>t</i> -test <sup>a</sup>	M-M-W <sup>b</sup>
	Mean	SD	Mean	SD	<i>p</i> -value	<i>p</i> -value
High costs of becoming certified	1.000	0.632	1.180	0.673	0.381	0.368
High costs of maintaining certification	1.000	0.775	0.989	0.672	0.963	0.962
Too time consuming	1.455	0.522	1.292	0.676	0.345	0.517
Tedious paperwork	1.455	0.688	1.348	0.682	0.628	0.608
No clear benefits derived from the certificate	1.000	0.775	0.725	0.703	0.275	0.227
Not needed	0.545	0.522	0.506	0.666	0.813	0.599

<sup>a</sup>Un-paired *t*-test (2 tailed) of means (heteroscedastic).

<sup>b</sup>Mann–Whitney–Wilcoxon rank sum test (2 tailed) of medians (adjusted for ties).

Average score: 0 for Not Important, 1 for Somewhat Important, 2 for Very Important.

firm more profitable and was a customer requirement. The data also suggests that the main reasons for both groups (i.e., agribusiness and other industries) are market oriented. Nevertheless, the idea that certification would reduce the firms' costs, suggests that firms also expected other benefits, aside from an enhanced market position. More importantly no statistical difference was found between the means or medians of the two groups of firms.

The primary reason, stated by the agribusiness subsample, for seeking certification was that ISO was expected to *provide a marketing/competitive advantage* whereas firms in the other industries stressed that ISO was expected to *turn the firm in to a leader among its competitors*. These results suggest that for agribusiness firms the market-oriented benefits of the certificate are still the main incentive to seek certification whereas for the other firms these marketing benefits are but a component of the overall benefits expected.

### 5.2. Arguments made against ISO 9000 before seeking certification

As can be seen in Table 3, the primary arguments made against ISO before seeking certification were that the process *was too time consuming* and that it involved *tedious paperwork*. This is to be expected because the QMS is highly document-based. The least important argument mentioned by both groups were that certification was *not needed*. This result is indicative that both groups of firms perceived the certificate as a necessity further nonagribusiness firms had reasonably clear expected benefits of the certificate. This may indicate a trend towards more informed decision making by the firms. Though ISO 9000 in general, and certainly in the U.S., is still a relatively new QMS, information about the systems' advantages and downfalls is becoming available. Regardless, there is a stronger ranking for the argument (no clear benefits) by agribusiness firms suggesting that information is not as clear for this industry. As the number of certified companies in a specific industry increases, the benefits and costs of the QMS become clearer to other companies that have not yet implemented the standard. More informed decisions can then be made by firms that are considering certification.



Table 4  
Comparison of firm's production process components after ISO 9000 certification

Elements of Comparison	Agribusiness		Other Industries		<i>t</i> -test <sup>a</sup> <i>p</i> -value	M-M-W <sup>b</sup> <i>p</i> -value
	Mean	SD	Mean	SD		
Costs	-0.091	1.044	-0.011	1.033	0.811	0.790
Sales	0.909	0.701	0.854	0.782	0.806	0.840
Market share	0.818	0.603	0.635	0.702	0.352	0.366
Profits	0.636	0.809	0.601	0.784	0.891	0.804
Managerial requirement	0.818	0.603	0.872	0.738	0.782	0.737
Product traceability	1.000	0.632	0.915	0.804	0.679	0.684
Customer satisfaction	1.000	0.447	1.006	0.733	0.970	0.930
Production non-conformities	-0.545	1.036	-0.348	1.126	0.553	0.509
Waste	-0.636	0.809	-0.539	0.903	0.708	0.702
Information quality	0.909	1.300	1.152	0.724	0.553	0.802
Firm's image	0.727	1.009	1.219	0.657	0.140	0.088*
Product's image	0.636	0.505	0.904	0.726	0.121	0.242

<sup>a</sup>Un-paired *t*-test (2 tailed) of means (heteroscedastic).

<sup>b</sup>Mann-Whitney-Wilcoxon rank sum test (2 tailed) of medians (adjusted for ties).

\*Statistically significant at the 10% level.

Average score: -2 for Large Decrease, -1 for Small Decrease, 0 for No Change, 1 for Small Increase, 2 for Large Increase.

### 5.3. Changes in firms' performance components after becoming ISO 9000 certified

Table 4 summarizes the changes that firms experienced after they obtained ISO 9000 certification (i.e., *ex post*). Even though these changes could have been influenced by other factors besides the certification process, they can be indicative of the effect of ISO 9000 on the firm's performance. The changes were measured in increases or decreases in the given categories using a balanced Lickert scale. The top changes for agribusiness and the other industries were computed as increases in the categories of *customer satisfaction*, *product traceability*, *information quality*, and *sales*. These are interesting results due to the fact that some of these same categories were not perceived as important reasons to seek certification in the first place. For example, *customer requirement*, was ranked sixth in the section addressing reasons to seek certification. Nevertheless, after the certificate was in place, the respondents ranked *customer satisfaction* as the category experiencing the biggest increase. This result is indicative of the fact that certified firms experienced an unexpected benefit from ISO 9000 in the form of increased customer satisfaction. This last finding contradicts earlier results found by Terziovski (1995). Regarding the increase in *information quality*, it can be said that this is an expected outcome of certification due to the fact that the ISO standard is so oriented towards documentation. It is therefore logical to assume that the quality of information available can only increase after implementing the standard. Regarding the increase in *sales*, the fact that the marketing aspects of the QMS were viewed as major reasons to seek certification would seem to indicate that the expectation of an enhanced market position due to ISO 9000 was well predicted.

The smallest changes in the firms' performance components experienced *ex post* were decreases in the areas of *costs*, *nonconformities*, and *waste* for both groups. This reduction

in waste entails a higher level of efficiency for the firms working under the QMS. Similarly, the reduction in nonconformities can be viewed as a component of enhanced efficiency through tighter process control. Regarding the small reduction in costs, it can be said that the costs due to the implementation and maintenance of ISO 9000 certification are offset by a perceived reduction in total costs. Even though the costs of implementing and maintaining the QMS were regarded as significant arguments against ISO 9000, the results suggest that the risk of investing any capital and labor on the certification project, was well taken.

Special attention has to be paid to the way that respondents ranked *Firm's Image*. Both groups reported an increase in this category after certification, but agribusiness firms reported a smaller value. Although the *t* test suggests that there is no statistically significant difference between the means of the two samples (e.g., at the 10% level), the nonparametric test rejects the null that the medians are equal at the 10% level. This suggests that the agribusiness subsample appears to be drawn from a distribution lying to the left of the larger sample. The lower values recorded by the agribusiness sector may be attributed to the fact that many agribusiness goods convey no information to the general public about the system under which the item is produced. 5 of the surveyed agribusiness firms stated that they produced final goods. This in turn means that very little, or no, further processing is required of these goods before reaching the final consumer. A certified firm is not allowed to use the ISO 9000 logo on its products (Jedd, 1993). Because of this, someone buying an “ISO orange” in a supermarket cannot tell the difference between that product and an orange produced by a firm that was not ISO certified. In this way it is logical to assume that firms producing final goods destined for the general public cannot expect, and will not perceive, the company's image of the firm to be enhanced by ISO certification. In this sense ISO differs from an environmental endorsement, certification, or label or green seal that can be displayed on the product's packaging (e.g., dolphin safe canned tuna).

#### 5.4. Changes in cost components after becoming ISO 9000 certified

Because the expense of ISO certification has always been perceived as one of the possible barriers towards implementation, special attention was paid to the different costs areas that could be affected after the QMS was in place. A detailed summary of the most important cost components is presented in Table 5. The biggest cost increases for all firms were in the areas of *audits* and *personnel*. This result is to be expected because the basis of the ISO series is a strong system of internal and external audits along with the documentation of processes. These activities foretell the use of more employee time and resources to complete the audits and address any identified nonconformances. Agribusiness firms reported a greater increase in personnel costs than that reported by firms in other industries. Conversely, the other industries reported greater increments in the costs accrued to audits as compared to agribusiness. This situation could be explained by the fact that agribusiness audits may require more labor, whereas the audits for a conceivably more complex production process observed in non agribusiness firms may require additional sophisticated calibration equipment and less personnel, thereby incurring higher overall costs.

As for the other components measured in Table 5, the biggest decrease in costs was reported in the areas of *waste* and *product rejections*. These two cost components ranked

Table 5  
Comparison of firm's production process costs components after ISO 9000 certification

Elements of Comparison	Agribusiness		Other Industries		<i>t</i> -test <sup>a</sup> <i>p</i> -value	M-W-W <sup>b</sup> <i>p</i> -value
	Mean	SD	Mean	SD		
Supplier contracts	0.182	0.751	0.146	0.639	0.880	0.906
Logistics	0.091	0.701	0.230	0.609	0.532	0.538
Audits	0.727	1.348	0.938	1.090	0.621	0.680
Inventory	0.364	0.809	-0.073	0.666	0.107	0.061*
Personnel (e.g., quality auditors)	0.818	0.603	0.596	0.676	0.262	0.303
Waste	-0.636	0.674	-0.537	0.754	0.646	0.721
Product rejections	-0.818	0.751	-0.534	0.958	0.254	0.278

<sup>a</sup>Un-paired *t*-test (2 tailed) of means (heteroscedastic).

<sup>b</sup>Mann–Whitney–Wilcoxon rank sum test (2 tailed) of medians (adjusted for ties).

\*Statistically significant at the 10% level.

Average score: -2 for Large Decrease, -1 for Small Decrease, 0 for No Change, 1 for Small Increase, 2 for Large Increase.

higher within agribusiness than for other industries indicating greater cost reductions. These results may be explained by the nature of agribusiness goods. In the other industries surveyed products that do not meet specifications may more easily be reworked to reach the required quality. If a radio does not work the distributor can send it back to the manufacturer and after fixing the problem (rework) the item can be reshipped. In the case of final agribusiness products in particular, there is little or no chance to rework goods that do not meet specifications. If the orange is not good enough for sale in a certain supermarket based on, for example, its appearance there is nothing that can be done to that orange to make it reach specifications. Any product that falls into this category is almost certainly lost as waste or at best transferred to another product class (e.g., juice) with lower value adding. In this sense, it is conceivable that a system that provides ways to ensure that a product meets customer's expectations, such as the ISO series, will reduce waste and nonconformities only in an industry where rework can solve the problem.

An interesting outcome of the survey results was the case of *inventory* costs. Agribusiness firms experienced an increase, whereas the firms in other industries experienced a small decrease. Although the *t* test cannot distinguish a statistically significant difference in the means at the 10% level the Mann–Whitney–Wilcoxon test reports the medians are unequal at this level, suggesting different distributions for the two groups of firms. Again the nature of agricultural goods may play a role in explaining this difference. It is expected (and partly demonstrated above) that ISO certification makes a firms' production process more efficient. This implies that inventories can be reduced with goods shipped shortly after production or processing. Under these circumstances one would expect a reduction in the costs of maintaining a smaller inventory. Such is the case for the nonagribusiness firms. However, in the case of agribusiness subsample this behavior is reversed. Due to the perishable nature of many final products of the agribusiness industry, more consistently meeting product specification may also imply that certain inventory control measures have to be implemented. Increased costs due to enhanced refrigeration facilities or measures to avoid mechanical and pathogenic damage should help to explain the differences between the two groups of firms.

This argument is reinforced by the findings that for agribusiness the costs of waste and product rejection experienced a larger decrease than that reported by the other industries. It seems that the higher costs accrued to inventory among agribusiness firms may be due not to increased quantity of inventory but the increased quality of the inventory control system.

## 6. Summary and conclusions

The results of the study imply that, for all other parameters measured, an agribusiness firm responds to ISO 9000 certification in much the same way as firms in other industries. Results of other studies (i.e., nonagribusiness orientated) may, therefore, be applicable to U.S. agribusiness. Nevertheless, in areas such as firm image, waste, product rejections, and costs of inventory control, the very nature of the agribusiness good may promote important differences and thus must receive special consideration and further analysis.

The results focusing on the relationship between ISO 9000 certification and trade suggest that firms wishing to establish a position in, conserve, or extend their presence in, the European market would be well advised to consider ISO certification. This will allow these firms to maintain a competitive advantage whereas meeting customer requirements. At the same time, additional (nonmarketing) benefits may be derived from the QMS.

The researchers believe that due to the recent embrace of the ISO 9000 series by firms from all industries, the original competitive advantage will eventually diminish as more firms implement the QMS. The next move of the early adopters of ISO 9000 should provide a good idea of what is in store for the agribusiness industry regarding quality management systems. The tendencies of these first movers to consider, adopt, or adapt quality systems based on HACCP principles, ISO 14000, or other third party certification programs should be the focus of future research. Further, certain comments of the survey respondents seem to indicate that ‘harmonization’ of the services provided by Registrars (the organizations that actually certify a plant’s QMS), and hence true standardization of ISO 9000 across nations, is an issue that remains to be fully evaluated.

## Notes

1. The authors are indebted to our reviewers who recommended this test due to the unequal sample sizes.

## Acknowledgments

This research was conducted whilst author Capmany was a graduate student at the University of Wageningen and visiting the Department of Agricultural Economics at Texas A&M University. This paper is based on a presentation given at the IAMA World Pre-Congress VIII *Building Relationships to Feed the World: Firms, Chains, Blocs*. Punta del Este, Uruguay. June 28–July 2 1998. The authors gratefully acknowledge the thorough efforts of two anonymous reviewers and the editors.

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