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**ISO 9000 Quality System Certification and its Impact on Product and Process  
Innovation Performance**

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### **Abstract**

ISO 9000 quality system certification has been widely applied around the world, but with mixed success. A review of the literature revealed gaps in research in this area of quality/operations management, particularly in the empirical testing of the effects of ISO 9000 certification on innovation performance. This study examines the impact of ISO 9000 certification on product and process innovation performance of 220 Australian organisations. Our results show that ISO 9000 certification does not have a statistically significant relationship with product innovation performance measures such time-to-market (TTM) of new products. ISO 9000 certification tends to drive out variance increasing activities, which in turn affects the organization's ability to innovate. Conversely, ISO 9000 certification has a positive and significant impact on process innovation performance measures such as restructuring and application of the internal customer concept. ISO 9000 certified firms are more likely to include restructuring, and to apply the internal customer concept throughout their organization to improve cooperation and to create flatter structures as part of their process innovation activities. The findings of this study have implication for managers and auditing bodies. Managers should exercise caution when choosing processes to certify, and auditing bodies should consider the paradox between product innovation and process innovation in the next revision of the ISO 9000 standard.

Key words: innovation performance, ISO 9000 certification, restructuring, internal customer concept.

## Introduction

There has been a major push by organizations around the world to seek certification to the ISO 9000 quality standard since its introduction in 1987 (Casadesus and Karapetrovic, 2005; Corbett, Montes-Sancho and Kirsch, 2005; Stevenson and Barnes, 2001; Terziovski, Samson and Dow, 1997). Although the ISO 9000 standard has undergone several changes over the past two decades and continues to be adopted by thousands of organizations throughout the world, there are significant gaps in the literature on empirical studies which test the strength of the relationship between ISO 9000 certification and innovation performance (Henkoff, 1993; Guler, Guillen & Macpherson, 2002; Naveh and Erez, 2004; Naveh and Marcus, 2005; Corbett et al., 2005).

Considerable research has been done on the impact of the ISO 9000 standard on operational and business performance (Corrigan, 1994; Henkoff, 1993; Stephens, 1994; Adler, 1999; Terziovski, Power and Sohal, 2003; Corbett et. al., 2005; Naveh et.al., 2004; Naveh et. al., 2005; Guler et. al., 2002).

However, research on the relationship between ISO 9000 certification and innovation performance has been mostly anecdotal. For example, a Business Week anecdotal article by Hindo (2007) argues that efficiency programs such as ISO 9000 certification are designed to reduce variation and eliminate waste, that could potentially stifle innovation (Terziovski, Sohal, and Power, 2003; Corbett et. al., 2005; Naveh et.al., 2004; Naveh et. al., 2005).

Academic research conducted by Gotzamani and Tsiotras (2002) draws similar conclusions that ISO 9000 certification increases bureaucracy and reduces innovation, and that the most important benefit gained from ISO 9000 certification is improvement of internal processes. On the other hand, Benner and Tushman (2003) argue that ISO 9000 certification may be more productive in stable environments where process innovation is more prevalent. Naveh and Erez (2004) report similar findings based on a longitudinal study, which concluded that ISO 9000 certification positively

affected attention to detail but negatively affected product innovation. In other words, when attention to detail and adherence to rules increased, innovation decreased.

A paradox has emerged from the above discussion. On one hand, managers are striving to reduce variation of their processes and hence improve quality and delivery of their products in full on time. On the other hand, product innovations call for different organizational skills that are based on learning from experimentation about customer need patterns and learning from product failure (Burgelman, Christensen, and Wheelwright, 2004; Benner and Tushman, 2002; Hino, 2007; Damanpour and Gopalakrishnan, 2001). We need to flesh-out the apparent paradox prior to articulating our research question (Terziovski, 2010).

Firstly, if we assume that ISO 9000 certification does not have a positive and significant effect on process innovation performance and it does, then we are likely to miss out on the benefits of increased formalization. For example, Prakash and Gupta (2008), argue that establishing organizational standards leads to employee commitment and an increase in organizational effectiveness. In addition, Adler (1999) argues that large-scale complex organizations need some formalized procedures in order to assure efficiency, conformance quality and timeliness.

On the other hand, if we assume that ISO 9000 certification does have a positive and significant effect on product innovation performance, and it does not, then we are likely to stifle product innovation performance. Adler (1999) further argues that organizations performing non-routine tasks and whose primary goal is innovation, such as the 3M organization, should be less bureaucratic and hence provide more focus on product innovation.

Swann (2010) summed up the paradox very well by stating that “...*the most innovative firms are good at finding information in standards, and, because they are ‘pushing the boundary’, they also find that regulations constrain their innovative activities.*” (p.1).

Based on the paradox discussed above, the objective of this paper is to address the research question

***Does ISO 9000 certification stifle innovation performance?***

The study makes a contribution to the literature by testing the strength of the relationship between ISO 9000 quality systems certification and product and process innovation performance. The study makes a further contribution through the application of the methods and techniques used to identify the influence of ISO 9000 certification on selected innovation performance variables illustrating how theories can be tested. Finally, the paper articulates implications for managers, researchers and accrediting bodies.

### **Literature Review and Development of Hypotheses**

In the following section we review the literature in order to establish a theoretical foundation based on past research and to develop research hypotheses (Sekaran, 1992). We briefly reflect on the changes that have taken place of the ISO 9000 standard, followed by definitions of key concepts, and the justification of the research hypotheses (Sarkis, 2003; Psomas and Fotopoulos, 2009).

A new version of the quality standard, ISO 9001:2008 was introduced in November 2008 to replace the ISO 9000:2000 version. A consistent view has emerged from the literature that the latest standard does not introduce any significant new requirements. Chinvigai, Dafaoui and Mhamedi, (2007) confirm that *“ISO 9001:2008 has little or minor changes from ISO 9001:2000. No new requirement and no significant change, rather than the clarification of some points...”* (p.2).

This is an important conclusion from the literature, given that our study was conducted with the earlier version of the ISO 9000 standard (Daniels, 1999).

### ***Definitions***

In this section we define quality, innovation and innovation performance, leading to the development of the hypotheses. There are many definitions of quality in the literature, depending on the context. The ISO 9000 quality standard is based on the conformance definition of quality to assure customers that a quality product or service will be supplied consistently (Casadesus and Karapetrovic, 2005; Corbett et al., 2005; Stevenson and Barnes, 2001; Terziovski, et al., 1997).

Similarly, there are many definitions of innovation in the literature. Innovation is often defined in the context of product and process innovation (Dougherty, 1992). For example, Gopalakrishnan and Bierly (2001) emphasise that product innovation relies on a competitive strategy based on differentiation, while process innovation relies on a cost leadership strategy (Gopalakrishnan and Bierly, 2001; Bessant and Tidd, 2007; Damanpour, 1991).

We have adopted the Oslo Manual (2005) definition of innovation for the purpose of this study: *“...the implementation of new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations.”* (p.9). Next we address the question of *how to measure innovation performance?* This question has been debated in the literature for quite some time (Damanpour, 1991; Molina-Azorín, Claver-Cortés, López-Gamero & Tarí, 2009).

For example, Keupp, Palmie & Gassman (2011), based on a systematic review of the literature of 342 articles on the strategic management of innovation concluded that *“...the majority of studies that analyse innovation outcomes employ a dependent variable which is based on patents, new product development or financial performance. The performance of process innovation is particularly hard to measure...”* (p.15). The authors recommend that future studies should use dependent variables that are *“...closely related to process innovation but underrepresented as dependent variables.”* (p.15).

Given the process-centred approach of the ISO 9000 standard with a focus on conformance, it is reasonable to assume that ISO 9000 certification is likely to have a stronger relationship with process innovation rather than product innovation performance (Marash and Marquardt, 1994; Manders, 2012).

### **Development of Hypotheses**

Based on the discussion above, we follow the advice from Keupp, et. al., (2011), to employ dependent variables in the development of the hypotheses which are underrepresented in the literature. However, given the comment from Subramanian and Nilakanta, 1996) that *“there is no prior research to guide*

*the formulation of specific hypotheses about substantive relationships between each dimension of organisational innovativeness...*" (p.637), our study should be considered exploratory in nature.

In the following section, we discuss the potential impact of ISO 9000 certification on product and process innovation performance, leading to the justification of our hypotheses (see Figure 1). The operationalization of the constructs included in the hypothesized relationships below are justified in the Methodology section under the heading 'Dependent Construct Measures.'

### ***Relationship between ISO 9000 certification and Time of Innovation Adoption***

Subramanian and Nilakanta (1996) define innovation adoptions as *"...organizational responses to external environmental changes."* (p.632). Therefore, time of innovation adoption is important from a 'first mover advantage' which can be potentially gained by firms that adopt innovations earlier than their competitors (Subramanian and Nilakanta, 1996). The authors propose that future studies on innovation adoption should utilize time-based measures for product innovation performance. Hence, we adapted the Damanpour and Evans (1990) approach (in Subramanian and Nilakanta, 1996), who measured innovativeness as the mean number of innovation adoption over a period of time (Bessant & Tidd, 2007).

It is important to briefly characterise the innovation cycle, which consists of the following stages: conception, proposition, adoption/implementation (Pierce and Delbecq, 1977; Damanpour, 1991; Klein and Sorra, 1996). The type of organizational structure required for the different phases of the innovation cycle remains unclear in the literature. For example, Damanpour (1991), based on a theoretical paper argues that a mechanistic organizational structure is less conducive to the adoption of innovation phase than a more organic structure.

On the other hand, Pierce and Delbecq (1977) argue that some formalisation of decision processes is required during the adoption/implementation phase of the innovation cycle in order to implement policies and procedures. This is consistent with Kaziliunas (2010) based on a research study who concluded that *"the more mechanistic and explicit knowledge based organizations will enjoy ISO*



*certification while the more organic and tacit knowledge organizations will experience tensions arising from a lack of fit.”* (p.87). However, this may not always be the case. For example, the Community Innovation Survey for Luxembourg, in Mangiarotti and Rillo (2010), found that ISO 9000 certification has a positive and statistically significant effect on non-technical innovation such as marketing (Mangiarotti and Rillo, 2010). Adler (1999) provides a pragmatic view, arguing that managers need to be selective in terms of when and where to adopt ISO 9000 certification.

From the above discussion it seems that there is a role for the ISO 9000 standard to play in the adoption/implementation phase of the innovation cycle. Therefore, we predict that ISO 9000 certified firms would adopt innovations quicker than non-ISO certified firms. This leads to our first hypothesis:

**Hypothesis 1:** *ISO 9000 certification has a positive and significant effect on the time of adoption of product innovation.*

#### ***Relationship between ISO 9000 certification and Time to Market (TTM)***

With the rapid advances in technology and the spread of globalization, organisations are striving to reduce TTM of new products. Various approaches have been used by managers to speed up the product innovation process, for example, through the implementation of cross-functional teams, collaboration with customers and suppliers, technology or internal or external organizational systems (Dougherty, 1992; Crawford, 1992; Klein & Sorra, 1996; Burgelman et al., 2004 Keupp, et. al., 2011).

Some authors argue for less structure to reduce TTM. For example, Crawford (1992) argues that reducing TTM of a product development project offers a quick response with new products to market changes. Lee (1998) conducted an empirical study of ISO 9000 certified firms in Hong Kong. The study tested the effects of ISO 9000 certification on several dimensions of operational performance and concluded that reduction in “lead time” or TTM received the lowest score. Lee (1998) concluded that “...short lead time might be achieved easier with the adoption of new technologies and equipment, which was out of the scope of ISO 9000.” (p.168).

Similarly, Wei (2010) in Manders (2012), based on a research study of several hundred companies in Taiwan found that the implementation of ISO 9000 certification had a negative and significant effect on product innovation performance. The study concluded that ISO 9000 certification resulted in a culture of attention to detail and not a culture of innovation. This is consistent with research findings in the photography industry by Benner and Tushman (2002) that as process management activities, such as ISO 9000 increased, product innovation decreased.

The other school of thought is that there are potential benefits to be gained from ISO 9000 certification if the organization pays particular attention to the implementation phase. For example, Yin and Schmeidler (2009) based on a research study found significant variability in the implementation of the ISO 9000 standard, confirming that “...it seems to be a common phenomenon that standardised management tools could be implemented very differently...” (p.470). Yin and Schmeidler’s (2009) statement may explain the contradictory findings from the literature.

Following the above discussion, we predict that ISO 9000 certified firms would have shorter TTM. This leads to our second hypothesis:

**Hypothesis H2:** *ISO 9000 certification has a positive and significant effect on the lead time of new products to market.*

### **Relationship between ISO 9000 and Ecological Efficiency/ Degree of Recycling**

Ecological efficiency/degree of recycling of products is becoming an important issue for the development of new products. Kleindorfer, Singhal and Wassenhove (2005) argue that organisations “...Do not pay attention to the end-of-life recovery of materials or energy, nor to proper disposal issues.” (p.488). The authors argue that a paradigm shift is required to recognize the importance of sustainable development in product design (Hart and Gautam, 1996).

According to Kleindorfer, et. al., (2005) organisations lack accountability for “...the energy and resources used and the resulting footprint they leave behind.” (p.484). In order to encourage firms to meet their environmental obligations, a performance scorecard was introduced called the Triple

Bottom Line reporting, which takes into account three key areas: environmental; economic and social measures (World Commission on Environmental Development, 1987). Ecological efficiency/degree of recycling is part of the environmental performance measures (Kleindorfer, et. al., 2005).

Whilst ecological efficiency can be a measure of both product and process innovation, Damanpour and Gopalakrishnan (2001) argue that product innovations are seen as more significant because customers are willing to pay higher prices for ecologically efficient and environmentally friendly products. For example, Shrivastava (1995) claim that firms that implement sustainable development practices in order to produce environmentally friendly products would achieve increased benefits.

Shrivastava (1995) used a case study on the 3M organisation to demonstrate how ecologically efficient products enabled the organisation to reduce operating costs and to improve corporate performance and firm reputation. The author argues that standards and regulation would encourage firms to respond to environmental problems.

Miles, Munilla, and McClurg, 1999) support this view, arguing that competitive advantage could be achieved if appropriate strategies, systems, and standards are put in place simultaneously (Banerjee, 2001; Bansal, 2005).

Following from the above discussion, we predict that ISO 9000 certified firms are likely to develop more ecologically efficient and recyclable products. This leads to our third hypothesis:

**Hypothesis H3.** *ISO 9000 certification has a significant and positive effect on ecologically efficient and recyclable products.*

### ***Relationship between ISO 9000 certification and Restructuring***

Restructuring is necessary for organizational survival. Narayanan (2001) identified formalisation and centralisation as two potential impediments of innovation performance. According to Narayanan (2001), informal communication and a more open climate would tend to facilitate process innovation,

arguing that the prime facilitators of innovation activity are informal organizational structures designed to encourage new ideas.

On the other hand, some authors take a more balanced view. For example, Douglas and Judge Jr (2001) discuss Shea and Howell's (1998) argument that an organisation needs to have a two dimensional approach to structure: *"...standardisation of TQM techniques and feedback loops helps an organisation control its systems and processes. However, decentralisation is also necessary to allow employees to explore and experiment with creative process improvement ideas."* (p.159).

There is strong research-based evidence in the literature that supports the relationship between ISO 9000 certification and TQM practice. For example, a study by Han, Chen and Elbrahinpour (2007) based on data collected from 441 ISO 9001 certified companies concluded that *"... ISO 9000 might be a good first step to total quality."* (p.1).

Overall, there is considerable convergence in the quality management practices adopted by ISO 9000 and TQM. Hence we developed our restructuring hypothesis based on the TQM literature, which has a much stronger theoretical foundation than the ISO 900 standard (Davenport, 1993; Powell, 1995; Douglas and Judge Jr., 2001; Samson and Terziovski, 1999; Kaynak, 2003).

Hence we predict that ISO 9000 certification would facilitate restructuring of process innovation. This leads to the fourth hypothesis:

**Hypothesis H4.** *Adoption of ISO certification has a positive and significant effect on restructuring of process innovation.*

#### ***Relationship between ISO 9000 certification and the Internal Customer Concept***

One of the key objectives of the ISO 9000 standard is to ensure that the structure and interrelationships are visible and clear to all concerned. According to Goult (2009) *"...It creates the process inter-linkage between functional activities, and is used to document the responsibilities and authorities of operational functions."* (p.42).

The internal customer concept is one of the underpinning principles of TQM (Samson and Terziovski, 1999; Evans and Lindsay, 2008). Many organisations have implemented the TQM philosophy, which is further underpinned by continuous improvement of processes, teamwork leading to customer satisfaction (Samson and Terziovski, 1999; Flynn, Schroeder, and Sakakibara, 2004).

Narayanan (2001) reinforces the point that communication and a more open climate where employees see themselves as internal customers and suppliers would facilitate process innovation (Narayanan, 2001; Flynn, et al. 2004).

Douglas and Judge Jr (2001) based on an empirical study found that standardisation of some TQM practices would facilitate control of systems and processes and conclude that “...*control and learning are mutually reinforcing.*” (p.165). Zuckerman and Hurwitz (1996) further reinforce the above, claiming that the ISO 9000 quality system helps to resolve work procedure inconsistencies, and conflict between formal and informal communication flows.

However, Naveh and Marcus (2005), based on an empirical study found that the ISO 9000 standard could produce inconsistent results if it's not implemented as a catalyst for change, stating that “*The different level of implementation yield firm-specific operating advantages, not uniformity as intended by the creators of ISO 9000 standard*” (p.23).

The authors conclude that point of differentiation could be achieved if firms were encouraged to focus on improving performance through the ISO 9000 certification implementation process, rather than the standard conformance approach to gain the ISO 9000 certificate (Ebrahimpour and Johnson, 1992).

Based on the above, we predict that the adoption of ISO 9000 certification would have a significant and positive effect on process innovation, underpinned by the internal customer concept. This leads to our fifth hypothesis:

**Hypothesis H5:** *The relationship between ISO 9000 certification and process innovation underpinned by the internal customer concept is positive and significant.*

## **Research Methodology**

In this section we discuss the research methodology. The unit of analysis was the company. Quantitative data was gathered through a random survey from site managers in the manufacturing, service, and computer and construction industries as part of an Australian Research Council (ARC) Discovery Project.

The population was selected from a Dunn and Bradstreet data file of 20,000 companies based on 12 industry codes of the Australian Standards Industry Classification (ASIC) system. The data set was designed based on three size categories defined by the Australian Bureau of Statistics (1999): “small” (20-49 employees), “medium” (50-99 employees) and “large” (100 or more employees). The final composition of the data set was 1,000 companies. The survey instrument was administered between October and December 2006. After checking responses 220 questionnaires were valid, which produced a response rate of 22 per cent.

### ***Respondent Profile***

Sixty-five percent of the respondents were CEOs, Managing Directors and General Managers. An analysis of the ownership of companies by size (using Australian sales) shows that 112 companies were privately owned with annual sales of under \$50 million. Most of the small companies were privately owned, with 82 respondents having sales below \$10 million. Public companies were both large and small, with 17 companies over \$50 million sales. Foreign owned companies were mainly large, with 9 companies having sales over \$50 million.

### ***Measurement Instrument***

The measurement instrument used in this study was originally developed for an Australian Research Council Discovery Project study. Questions associated with ISO 9000 and innovation performance were included in the survey instrument. The questions in the survey instrument were designed using

the 5-point modified Likert scale. The survey instrument was pilot tested in 25 organizations chosen at random.

The independent construct of interest in this study is *the degree of ISO 9000 certification* (Table 1 in the Appendix), derived from Question 5.8 of the survey instrument (Australian Research Council Discovery Project Survey Instrument, 2005). Site managers gave their perceived responses on a Likert scale of 1 *'already certified and seeking further upgrading'* to 5 *'no immediate plans for certification.'*

The dependent constructs of interest in this study are product innovation performance and process innovation performance included as Question 6.0 of the survey instrument. Site managers gave their perceived responses as part of ordinal variables described in Table 2 of the Appendix. In the following section we argue why the current operationalizing of the product and process innovation constructs.

### ***Dependent Construct Measures***

There are significant gaps in research conducted on the relationship between ISO 9000 certification and innovation performance (Subramanian and Nilakanta, 1996). An in-depth study of the strategic innovation literature conducted by Keupp et. al., (2011) concluded that *"...while there are few conceptual articles and qualitative case studies on innovation implementation, empirical evidence is largely missing."* (p.13).

The product innovation construct was developed with reference to studies conducted by Subramanian and Nilakanta (1996); Prajogo, and Ahmed (2007). The process innovation construct was developed with reference to a study conducted by Douglas and Judge Jr (2001). As mentioned in the hypotheses development section, given the arbitrary selection of our dependent constructs, our study should be considered as exploratory.

### ***Product Innovation Construct***

Prajogo and Ahmed (2007) synthesized criteria for the development of innovation performance constructs from previous empirical studies of innovation (Subramanian and Nilakanta, 1996; in Prajogo and Ahmed, 2007). Further to our previous discussion on the justification of the hypotheses, we used three items from the Prajogo and Ahmed (2007) criteria that we considered to be closely aligned with the product innovation construct.

We were also guided by Subramanian and Nilakanta (1996), who found that time-related measures were not widely used in research studies when compared to other performance measures, concluding that *“Time-related measures are seen to represent a promising opportunity to broaden knowledge about performance in the context of innovation speed”* (p.5).

#### ***(a) Being the ‘first’ in the market relates to our ‘time of innovation adoption’***

The literature on innovation adoption discussed in the hypotheses development section is primarily focused on assessing innovation at one point in time. Naveh and Erez (2004) emphasised the need to consider product design in the ISO 9000 implementation process *“A major requirement of the ISO 9000 standard is that organisations develop and implement a set of routines and procedures for product design, manufacturing, delivery, service and support...”* (p.1578), this is consistent with the latest criteria of the ISO 9000 standard. Therefore, we have chosen *Time of Innovation Adoption* as an important variable to include in the product innovation construct (Poolton, and Ismail, 2000).

#### ***(b) The speed of innovation relates to our ‘time to market’ (TTM)***

Douglas and Judge Jr (2001) argue that innovation speed *“is one of the most important measures for assessing a firm’s innovation performance in practice.”* Also, Benner and Tushman (2003:249) believe that *“...tighter coordination and repetition of activities embedded in standardized best practices increase an organization’s speed and efficiency.”* (p.159).



However, research on the impact of ISO 9000 certification on product innovation, which specifically addresses the TTM dimension is rather scarce. Hence, our choice of this dimension as part of the product innovation construct should be treated as exploratory.

***(c) The level of innovativeness (novelty of newness of the aspect), relates to our ‘ecological efficiency through product recyclability.’***

According to Kleindorfer et. al., (2005) a paradigm shift is required to recognize the importance of sustainable development is product design. Damanpour and Gopalakrishnan (2001) argue that product innovations are seen as more significant because customers are willing to pay higher prices for ecologically efficient products.

However, there is insufficient evidence in the literature on the impact of ISO 9000 certifications on the end-of-life recovery through new product development (Debo et al. 2005). Metz et. al. (2007) in Terziovski (2007) refers to end-of-life recovery as ‘*ecological efficiency through product recyclability.*’ (p.19). Based on the above, we predict that ISO 9000 certified companies are more likely to have a positive and significant impact on the design of ecologically efficient products (Molina-Azorín et. al., 2009).

### ***Process Innovation Construct***

Subramanian and Nilakanta (1996) argue that process innovation performance is difficult to measure since most of the measures in the literature focus on product innovation. This further reinforces our current operationalizing of the Process Innovation construct: *the degree of restructuring* and the *extent to which ISO 9000 certification impacts on the internal customer concept*. Since our study is the first to use the dependent variable dimensions, the study should be considered as exploratory. In future studies, the number of dimensions in the process innovation construct should be increased so that reliability of the scales could be increased (Douglas and Judge Jr., 2001; Corrigan, 1994).

#### ***(d) Restructuring***

The choice of this dimension was largely dependent on Douglas and Judge Jr (2001) article which discusses Shea and Howell's (1998) argument that an organisation needs to have a two dimensional approach to structure: *"...standardisation of TQM techniques and feedback loops helps an organisation control its systems and processes..Decentralisation is also necessary to allow employees to explore and experiment with creative process improvement ideas."* (p.159).

There is general agreement in the literature that ISO 9000 certification is a first step toward the creation of a TQM culture in the organization (Evans and Lindsay, 2008). However, there is very little research which tests the potential of ISO 9000 certification to act as a catalyst of change. According to Naveh and Marcus (2005), ISO 9000 can be used as a catalyst for change when the quality systems certification practices are uniquely implemented in the day-to-day operations (Flynn et. al., 2004).

#### ***(e) Internal Customer concept***

The internal customer concept is of interest to both ISO 9000 quality system certification and TQM implementation (Forker, Mendez and Herhauser, 1997). We chose the TQM literature to justify the internal customer concept, because there are strong links between TQM and the ISO 9000 standard. For example, Martinez-Costa and Martinez-Lorente and Choi (2008) based on an empirical study concluded that *"...if the motivation for implementing ISO 9000 is internal, what the company is doing in essence was to increase TQM practices."* (p.24).

Generally, research shows that the internal customer concept facilitates collaboration between various functional areas within organisations (Dougherty, 1992; Evans and Lindsay, 2008; Powell, 1995; Douglas and Judge Jr, 2001). Naveh and Marcus (2005), based on a research study conclude that *"...ISO 9000 can and should become the springboard for rethinking the way a company does business and a point of departure for additional innovations."* (p.5).

Hypotheses H1 through H5 are summarized in Table 2. The constructs model is delineated in Fig. 1.

### ***Assessment of Potential Non-Respondent Bias and Common Method Bias***

A survey of non-respondents was conducted to test whether there was any response bias in the sample. Questions were asked by telephone survey to 50 randomly selected non-respondents from the original survey. Analysis of the results revealed that there was no significant response bias in the sample. Therefore, in such a large random sample, there is no reason to believe that the respondents were any different to the population of plant managers.

A frequent design problem in surveys is the common method bias, which is detrimental to validity of the research (Podsakoff et al., 2003). We use a Harman's Test approach and perform a single-factor exploratory factor analysis (EFA) on the dependent variables detailed in Table 2.

The result of the EFA shows that percent of total variance explained by a single unrotated factor is 30.85 percent, and a chi-square test to determine whether a single factor was pertinent to describe the data was rejected at  $\alpha = 5\%$  ( $p = 0.034$ ) (using SAS jmp software). These results indicate the common variance is not a problem in this research.

### ***Data Preparation***

Three stages of data preparation were performed prior to conducting the main analyses. The first stage involved the selection of questions to include in the final data set. Given the diverse nature of organizations in this study, many of the survey questions were found not to be relevant to the research questions posed in this study.

The second stage of data preparation was the screening for outliers, and checking the normality of the data. The third and final stage of data preparation was treatment of incomplete responses. All cells in the data set needed to be complete for Multiple Regression Analysis (Hair, Anderson & Tatham, 1992).

If any response had more than six empty cells among the variables, then the entire response was deleted from the data set. The percentage of empty cells was very low ( $<1\%$ ).

## **Data Analysis**

### ***Exploratory Data Analysis***

Validity and reliability are two separate but interrelated conditions (Hair, et al., 1992). We need to check how accurate (valid) are our dependent variable measures of product and process innovation. We also need to check how consistent (reliable) our dependent measures are (Hair et al., 1992). As an element of convergent validity, we consider the Cronbach's alpha for dependent variables, innovation performance, is acceptable at an unbiased reliability coefficient 0.7.

We also consider the strictly parallel models (Kristof, 1963), which determine that the true item scores have the same mean and variance. Both, of them were rejecting at  $\alpha = 5$  percent, with  $\chi^2 = 340.906$  (p-value=0) for the parallel model and with  $\chi^2 = 620.488$  (p-value= 0). Therefore, both tests were rejected. The latter tests simply indicate that the true item scores have different means and variances.

### ***Structural Equation Model***

As a second phase of the exploratory stage, structural equation modeling was performed. Fig 2 shows structural equation model proposed based on our literature review and the hypotheses delineated in the paper. We first approached SEM considering that all manifest variables to be continuous and second SEM approach was to divide the manifest variables between ordinal and continuous as determined by the questions in the questionnaire (Flora and Curran, 2004). Table 3 shows different fit indices for first and second CFA approaches using M-plus software (Hooper, Coughlan and Mullen, 2008).

Hu and Bentler (1999) suggested that a good fit is determined when jointly the values of Root Mean Square Error of Approximation (RMSEA) is 0.06 or lower and a Standardized Root Mean Square Residual (SRMR) of 0.09 or lower. Both approaches are considered adequate to represent the latent model. The two indices were chosen in order to determine the goodness of fit of the model. The RMSEA tells us how well the model, with unknown but optimally chosen parameter estimates would

fit the population's covariance matrix (Hooper et al., 2008). The SRMR is a measure of the average size of residuals between the fitted and sample covariance matrices (Hu and Bentler, 1999). These authors suggest that a good fit is determined when jointly the values of RMSEA is 0.06 or lower and a SRMR of 0.09 or lower. Both approaches are considered adequate to represent the latent model proposed in Figure 2.

### ***Testing of Hypotheses***

#### ***Product Innovation Performance – Hypotheses H1, H2 and H3***

In this section we test the research hypotheses for product innovation using the Kendal Tau-b, which is a more robust correlation coefficient under a wide variety of data distribution. The data analysis involved the partitioning and identification of variation in the dependent variable, product innovation performance, due to the independent variable, ISO 9000 certification.

From the correlation analysis provided in Table 4, we observe that ISO 9000 certification has a significant but negative correlation with time of innovation adoption ( $r = -0.113$ ,  $p = 0.054$ ). Checking the wording of the question ISO 9000 question (see Table 1), as the level of ISO 9000 certification increases, the time of innovation adoption takes longer. Therefore, Hypothesis H1 is rejected.

With reference to Table 4, we observe that ISO 9000 certification has a significant but negative correlation with Time to Market (TTM), ( $r = -0.210$ ,  $p = 0.001$ ). Checking the wording of the question in the survey instrument and the direction of the Likert scale, we interpret that as the level of ISO 9000 certification increases, the time to market increases. Therefore hypothesis H2 is rejected.

ISO 9000 certification has a significant but negative correlation with ecological efficiency/degree of recycling ( $r = -0.154$ ,  $p = 0.009$ ). Checking the wording of the question and the direction of the Likert scale, we interpret that as the level of ISO 9000 certification increases, ecological efficiency/degree of recycling increases. Therefore Hypotheses H3 is supported. These conclusions are summarized in Table 4.

### *Process Innovation Performance – Hypotheses H4 and H5*

We predicted that organizations are more likely to seek ISO 9000 certification if restructuring is part of their innovation philosophy. From Table 4 we observe a negative but significant correlation ( $r = -0.118$ ,  $p = 0.046$ ). Checking the wording of the question and the direction of the Likert scale, as ISO certification increases, certified companies are likely to have restructuring as part of their innovation philosophy. Therefore, we support hypothesis H4.

We also predicted that if the internal customer is understood throughout the organization, there is likelihood that ISO 9000 certification would be in place. From Table 4 we observe a negative but significant relationship ( $r = -0.156$ ,  $p = 0.009$ ). After checking the wording of the question and the direction of the Likert scale, we deduce that as the level of ISO 9000 certification increases, the level of understanding of the internal customer concept increases. Therefore hypothesis H5 is supported.

### ***Explanatory Modeling: Univariate Ordinal Logistic Regression Analysis***

The dependent variables considered in this research are ordinal in nature. Ordinal logistics regression is used to create an explanatory model of the influence of ISO 9000 certification. Our analysis is based on Ordinal Logistic Regression Analysis. Table 5 illustrates three significant dependent variable in our model, namely for internal customer concept, time to market (TTM) and ecological efficiency/degree of recycling at  $\alpha = 5\%$ .

### ***Post-estimation for the Ordinal Logistic Regression***

This post-estimation approach determines the probability associated with each category of the significant dependent variables considered in the ordinal logistic regression and we compare them with the observed category proportions, this is summarized in tables 6 and 7. Namely, for each significant dependent variable in our model, namely for *Internal customer concept*, *Time to market* (TTM) and *Ecological efficiency degree of recycling*, a estimation approach was performed to determine the predicted probabilities of each variable category using ordinal logistic regression with Stata 11 post estimation procedure. In the following section we consider the two Innovation

Performance constructs, namely Product Innovation Performance and Process Innovation Performance.

In the Product Innovation construct, there were two dependent highly significant variables, namely time to market (TTM) and ecological efficiency/degree of recycling as suggested by the p-values of Table 5. As an example, Table 6 shows the results for ecological efficiency/degree of recycling predictions of level probabilities. A comparison of observed and predicted probabilities shows the adequacy of the ordinal regression model for the data.

In the Process Innovation construct, there was one dependent highly significant variable, namely internal customer concept as suggested by the p-values of Table 5. Table 7 shows the results for ecological efficiency/degree of recycling predictions of level probabilities. A comparison of observed and predicted probabilities shows the adequacy of the ordinal regression model for the data.

## **Discussion of Results**

The data analysis showed mixed results on the relationship between ISO 9000 certification and product innovation performance dimensions. Our prediction that companies certified to ISO 9000 would take less time to adopt an innovation and their lead-time to market would decrease, was incorrect, therefore, H1 and H2 were rejected. This leads us to the conclusion that ISO 9000 certification does not appear to be suited to product innovation. Our results are consistent with Benner and Tushman (2002) and Naveh and Erez (2004) research findings, which conclude that ISO 9000 certification had a negative effect on product innovation performance.

One possible explanation of this finding is that whilst the ISO 9000 aims to standardize by focusing on assuring customers that they will consistently receive products and services at a level of quality which has been agreed with the customer, the attention to detail adds to the TTM. This is confirmed by Naveh and Erez (2004) in their Management Science article, which found that “*ISO 9000 positively affected attention to detail and negatively affected innovation.*” (p.1576). Following from

the above, ISO 9000 would tend to facilitate a culture of conformance improvement rather than performance improvement (Douglas, Kirk, Brennan, and Ingram, 1999).

A study by Yin and Schmeidler (2009) provides a much more plausible explanation. Based on a survey of US 14001 certificate holders, the researchers found that variability in the implementation of the ISO standards may explain the contradictory findings from the literature. With empirical support advanced by the resource-based view of the firm, Yin and Schmeidler (2009) concluded that *"...standardized management systems may be implemented differently in different organisations."* (p.23).

Based on this discussion, it is reasonable to speculate that ISO 9000 could lead to competitive change (Dimara, Dimitris and Kostas, 2004). Further explanation of the negative effects of ISO 9000 certification on time of innovation adoption and TTM is provided by a comprehensive study conducted by Naveh and Marcus (2005). The researchers concluded that where ISO 9000 certification was used as a catalyst for change, organisations achieved a distinctive advantage through the effective implementation process *"The different level of implementation yield firm-specific operating advantages, not uniformity, as intended by the creators of ISO 9000."* (p.23).

Lee (1996), based on a study of Hong Kong certified firms, found that the TTM measure was least influenced by ISO 9000, and concluded that TTM can be achieved through new technology rather than an ISO 9000 standard (Gopalakrishnan and Bierly, 2001).

Our prediction that ISO 9000 certification would increase ecological efficiency/degree of recycling of new products was correct therefore H3 is supported. This finding can be explained by the ongoing paradigm shift which is taking place in organisations around the world. End of recovery of products (ecological efficiency) has accelerated since the introduction of environmental accountability and the Triple Bottom Line (TBL) reporting (Larson, 2000). The principle of the TBL requires organisations to report on the usage of resources and the resulting environmental footprint they create (Kleindorfer et. al, 2005).



In addition to the above discussion, many organisations implement ISO 9000 and ISO 14000 Environmental Management Systems (EMS) certification jointly because of the synergistic effect of sharing the documentation Wagner (2008). It is reasonable to speculate that improvement of ecological efficiency may not be entirely due to ISO 9000 certification. It could be because many companies implement both systems at the same time. Overall, our results are supported by Wagner (2008) who concluded that an ISO 14001 certification is positively associated with process innovation and weakly associated with product innovation (Klein and Sorra, 1996).

Our prediction that ISO 9000 certification would facilitate restructuring of processes was correct, therefore H4 was supported. This is consistent with findings by Benner and Tushman (2003) that the implementation of process innovation practices provide an enabling structure that allows for more efficient horizontal coordination of activities. This finding can further be explained by research conducted by Damanpour and Gopalakrishnan (2001).

The authors argue that if an organization has an interest in quality control and reengineering of their processes, they are likely to be motivated to improve the efficiency of their processes (Holland and Kumar, 1995). This explanation is also supported by Benner and Tushman (2003) “...*standardized best practices increase an organization’s speed and efficiency.*” (p.249). However, this applies to process innovation rather than product innovation, as discussed above with evidence from the literature.

Our prediction that ISO 9000 certification would have a significant and positive effect on process innovation, underpinned by the internal customer concept was correct, therefore, Hypothesis H5 was supported. In order to explain why H5 was supported, we draw on the earlier discussion we had on the TQM philosophy.

The internal customer concept is of interest to both ISO 9000 quality system certification and TQM implementation. We provided research evidence to demonstrate the strong link between ISO 9000 and TQM (Han, Chen, and Ebrahimpour, 2007). Research shows that TQM and ISO 9000 practice helps

to break down ‘silos’ between departments, and facilitates collaboration between various functional areas within organisations (Evans and Lindsay, 2008; Powell, 1995; Douglas and Judge Jr, 2001).

Our support of Hypothesis H5 is also consistent with research findings by Zuckerman and Hurwitz (1996) in Stevenson and Barnes (2001), who found that ISO 9000 certified firms improve cooperation, resolve work procedure inconsistencies, and conflict between formal and informal communication flows, by understanding and practicing the internal customer concept.

## **Conclusions**

With respect to the research question, *Does ISO 9000 certification stifle innovation performance?*

This study concludes that the relationship between ISO 9000 certification is statistically insignificant with product innovation performance and statistically significant with process innovation performance. Therefore, it is reasonable to conclude that ISO 9000 certification is likely to stifle product innovation performance, but would likely facilitate the improvement of process innovation performance through the formalization of structure and the enabling of cooperation and communication between functional areas through the application of the internal customer concept.

Our findings also support the research finding from Naveh and Erez (2004) that ISO 9000 standard can act as a catalyst for change. For example, ISO 9000 certified firms are more likely to include restructuring, and to apply the internal customer concept throughout their organization to improve cooperation and to create flatter structures as part of their process innovation activities (Rahman, 2000; Prakash, and Gupta, 2008).

## **Implications for Contemporary Practice**

Given the limited empirical evidence linking ISO 9000 certification with innovation performance, the findings of this study have potential implications for managers, researchers and accrediting bodies. Managers should exercise caution when choosing a particular process to certify. ISO 9000

certification should be introduced as part of a long-term continuous improvement philosophy, instead of just obtaining an ISO 9000 certificate.

Managers should also be aware that the presence or absence of ISO 9000 certification is not a strong predictor of innovation performance. Naveh and Erez (2004) argued that multiple practices are required in order to improve innovation performance. Where ISO 9000 certification is implemented effectively, it may act as a “catalyst” for facilitating process innovation. Additional research is required in order to examine how this could be achieved.

Researchers should be aware that the validity of the ISO 9000 certification process should be questioned as an indicator of innovation performance. The purely cross-sectional data set only provides an association between ISO 9000 certification and product innovation performance, which does not strictly prove that ISO 9000 causes product innovation performance to decrease. This may be caused by some third factor not measured in this study.

Auditing bodies should consider the paradox between product innovation and process innovation in the next revision of the ISO 9000 standard. The International Standards Organisation (ISO) should consider promoting the ISO 9000 standard as a catalyst for change, and to recognize that firm-specific implementation of the ISO 9000 standard may potentially lead to sustainable competitive advantage.

We draw further implications by addressing the paradox that we articulated in the introduction of this paper. An abbreviated version of the paradox can be paraphrased as follows: Whilst the prime objective of the ISO 9000 standard is to reduce process variation in order to reduce failure and improve quality, paradoxically, product innovations are based on learning from experimentation and failure.

One way to better understand the paradox is for managers to use ISO 9000 standard for the purpose of improving performance through process innovation, rather than just conforming to a standard and gaining a certificate (Marlow, Taylor and Thompson, 2010).

Adler (1999) sums up very well, by arguing that complex organizations need some formalized procedures in order to assure efficiency and quality. However, some organisations need formalized procedures more than others. For example, an organization such as 3M, whose culture is based on creativity and innovation should be less bureaucratic and hence provide more focus on product innovation, rather than process innovation through the implementation of the ISO 9000 certification.

### **Limitations of the Study and Future Research**

Given the age of the data set there are potential limitations of this study. However, a consistent view has emerged from the literature that the latest version of the standard, ISO 9001:2008 has not changed the intent of its predecessor, ISO 9001:2000 and does not introduce any significant new requirements. Therefore, it is reasonable to claim relevance of our findings to organizations that have been certified to the ISO 9001:2008 standard (Goult, 2009).

Since our study is one of the first to use underrepresented dependent variables that are closely related to product and process innovation, the study should be considered as exploratory. Future research should consider increasing the number of dimensions in the product and process innovation constructs so that reliability of the scales could be increased (Douglas and Judge Jr (2001).

Future research is recommended which would examine the relationship between ISO 9000 with innovation performance over a 3-5 year time frame. This could be a structured study using a statistically credible sample and multivariate data analysis methods. In addition to cross-sectional surveys, in-depth case studies should be triangulated with the longitudinal study.

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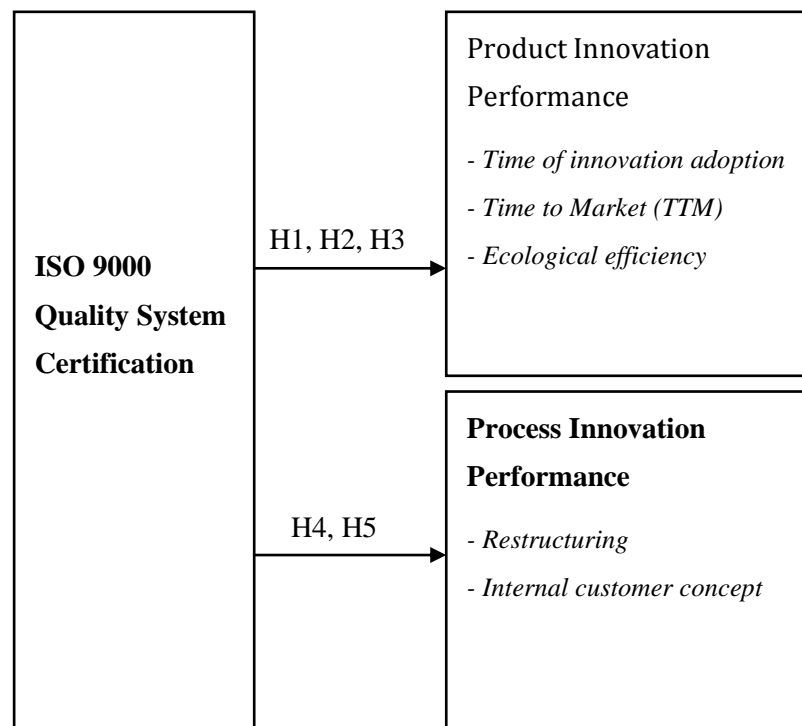
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## Appendices

**Table 1** - Independent Variable: ISO 9000 Certification

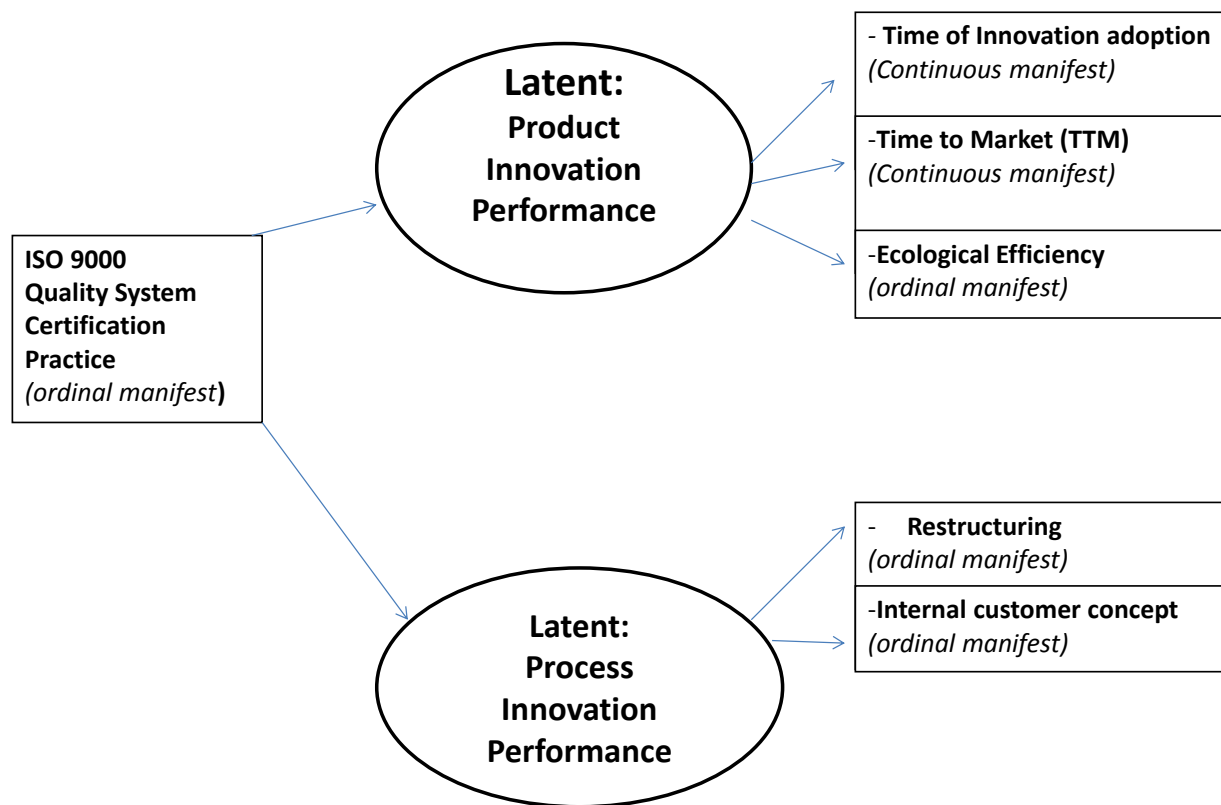
5.8.h) Where does your organization fit in relation to ISO 9000 certification or other relevant industry standards (Please circle ONE number only)

- |  |   |
|--|---|
| a. Already certified and seeking further upgrading | 1 |
| b. Already certified                               | 2 |
| c. Currently undergoing certification              | 3 |
| d. Seeking certification within the next 12 months | 4 |
| e. No immediate plans for certification            | 5 |

**Figure 1 - Theoretical Model**

**Table 2** - Dependent Variables (Excerpts from Questionnaire)

RELATED HYPOTHESES	QUESTIONS QUESTIONNAIRE	DEPENDENT ORDINAL VARIABLES	1	2	3	4	5
		PRODUCT INNOVATION VARIABLES					
H1	6.1 (b)2	The time of innovation adoption	< 1year	1 year	2 years	3 years	<3 years
H2	6.1 (c)	Time to market (TTM)	1 year	2 years	3 years	4 years	5 years
H3	6.1 (g)	Ecological efficiency/ degree of recycling	Very Low	Low	Satisfact ory	High	Very High
		PROCESS INNOVATION VARIABLES					
H4	5.8 (d)	Restructuring	Strongly disagree				Strongl y agree
H5	5.8 (e)	Internal customer concept	Strongly disagree				Strongl y agree

**Figure 2** - Structural Equation Modeling

**Table 3 - Structural Equation Modeling - Fitting the Mode**

<b>Chi-Square Test of Model Fit</b>	<b>All manifest Variables are Continuous</b>	<b>All manifest Variables are Continuous and Ordinal</b>
Value	8.973	9.989
Degrees of Freedom	7	7
P-Value	0.2546	0.189
RMSEA		
Estimate	0.038	0.047
Probability RMSEA <= .05	0.548	0.467
CFI/TLI		
CFI	0.957	0.936
TLI	0.908	0.864
<b>SRMR (Standardized Root Mean Square Residual)</b>		
Value	0.043	0.0543

**Table 4 - Kendall's Tau-b Non-Parametric Correlation Analysis with ISO 9000**

<b>PRODUCT INNOVATION VARIABLES</b>		<b>Correlation with ISO 9000</b>
The time of innovation adoption	Correlation Coefficient	-.113
	Sig. (2-tailed)	.054*
	N	204
Time to market (TTM)	Correlation Coefficient	-.21***
	Sig. (2-tailed)	.001
	N	200
Ecological efficiency/degree of recycling	Correlation Coefficient	-.154***
	Sig. (2-tailed)	.009
	N	200
<b>PROCESS INNOVATION VARIABLES</b>		
Internal customer concept	Correlation Coefficient	-.156***
	Sig. (2-tailed)	0.009
	N	206
Restructuring	Correlation Coefficient	-.118**
	Sig. (2-tailed)	0.046
	N	205

\*\*\* Correlation is significant at the 0.01 level (2-tailed). \*\*Correlation is significant at the 0.05 level (2-tailed) \*Correlation is significant at the 0.10 level (2-tailed).



**Table 5 - Ordinal Logistic Regressions**

<b>Hypotheses</b>	<b>Dependent Ordinal Variables</b>	<b>Link Function for Ordinal Logistic Regression Analysis</b>	<b>Is ISO 9000 Certification useful to describe the variables? □ = 5%</b>	<b>p-Value</b>	<b>Pseudo R-square (Negelkerke) (%)</b>
	<b>Product Innovation Performance</b>				
H1)	The time of innovation adoption	NEGATIVE LOG-LOG	No	0.115	3.9
H2)	Time to market (TTM)	NEGATIVE LOG-LOG	Yes	0.00***	6.9
H3)	Ecological efficiency/degree of recycling	PROBIT	Yes	0.01***	6.5
	<b>Process Innovation Variables</b>				
H4)	Restructuring	LOGIT	No	0.074*	4.4
H5)	Internal customer concept	COMPLEMENTARY LOG-LOG	Yes	0.038**	5.6

\*\*\* Correlation is significant at the 0.01 level (2-tailed). \*\*Correlation is significant at the 0.05 level (2-tailed) \*Correlation is significant at the 0.10 level (2-tailed).

**Table 6 - Post-Estimation for Product Innovation Performance**

<b>Levels for Ecological efficiency/degree of recycling Model: PROBIT</b>	<b>Observed levels probability</b>	<b>Predicted levels probability</b>	<b>Time to market (TTM)  Model: NEGATIVE LOG-LOG</b>	<b>Observed levels of probability</b>	<b>Predicted levels probability</b>
Very low	.209	.217	1 year	0.497	0.502
Low	.234	.240	2	0.268	0.264
Satisfactory	0.370	.357	3	0.141	0.143
High	.126	.130	4	0.048	0.043
Very high	.058	.054	5	0.043	0.046

**Table 7 - Post-estimation for Process Innovation Performance**

<b>Internal customer concept</b> <b>Model: NEGATIVE LOG-LOG</b>	<b>Observed levels</b> <b>probability</b>	<b>Predicted levels</b> <b>probability</b>
1	0.094	0.009
2	0.109	0.112
3	0.289	0.288
4	0.402	0.399
5	0.189	0.189