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Reliable and flexible Quality Management Systems in the automotive industry: monitor the context and change effectively

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Abstract

Suppliers have an increasing role in the automotive industry and Quality Management Standards (QMS) are key requirements to ensure a competent supplier network, with properly selected and qualified suppliers.
By surveying IRCA registered auditors concerning ISO 9001:2015 certified organizations, this research highlights the need for the automotive industry OEM and Suppliers to properly monitor the organizational (internal and external) context and identify the key issues that affect the ability of their QMS to deliver quality products, and to plan, design, implement and control change in an effective and timely manner, within the whole supply chain.

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1. Introduction

The International Organization of Motor Vehicle Manufacturers (OICA) states that 60 million vehicles are built annually, employing about 9 million direct people (5 percent of the world's total manufacturing employment) with an additional 50 million indirect jobs in other related industries [1]. Due to its global footprint, the automotive industry has been a major focus of studies both by academia and media.

This industry is presently confronted with considerable challenges, such as increased competition, more brands, models and complex vehicles, tighter regulatory requirements (e.g., emissions), and the need to manage global supplier networks with shorter development cycles.

To respond to customer demands and to improve business performance, more than 1 million organizations, of all activity sectors worldwide, have implemented ISO 9001 International Standard Quality Management Systems (QMS) [2]. Considering the specific characteristics and challenges of the automotive industry, the sector has relied on ISO 9001 and ISO TS 16949 (to supplement ISO 9001 International Standard requirements), aiming for QMS that provide customer satisfaction while emphasizing defect prevention and the reduction of variation and waste in the supply chain. Within the automotive industry (e.g. ISO TS 16949) there is an additional emphasis on quality tools and techniques, such as product and process FMEA (Failure Mode and Effect Analysis), SPC (Statistical Process Control), MSA (Measurement System Analysis), and the use of APQP (Advanced Product Quality Planning) and PPAP (Production Part Approval Process).

Customers expect their vehicles to be innovative, safe, reliable and have a great performance at a reasonable price, which requires defect-free supply chains for manufacturing, producing and servicing vehicles and supplying replacement parts. However, the increased number of model variants and the extensive use of electronic components involving complex software, combined with time cost pressures, has led to an increase in the number of recalls.

In the US, per the National Highway Traffic and Safety Administration (NHTSA) the number of auto recalls has risen from approximately 24 million in the year 2000 to 64 million in 2014 [3]. Garvin [4] considers that product recalls are a manifestation of poor quality. They are an example of external failure costs and can negatively impact firms' financial and market performance making a solid case for the use of effective QMS in the automotive industry, as supported by Sabbagha et al. [5].

With the purpose of ensuring that ISO 9001 remains actual in a world of increasingly complexity and interconnection, ISO issued the revised ISO 9001:2015, with novel and reinforced approaches [6]. Croft et al. [7] support the view that ISO 9001.2015 does deliver value to the organizations that adopt it. This lead to the development of the revised automotive quality management system standard IATF 16949, by the International Automotive Task Force (IATF) that should be comprehended as a supplement to, and used in conjunction with, ISO 9001:2015 [8]. While ISO 9001:2015 is more focused on the organization and its customers (and relevant interested parties that influence the quality of the organization products), IATF 16949 greater emphasizes the OEM (Original Equipment Manufacturer) and statutory and regulatory requirements, emphasizing defect prevention and the reduction of variation and waste in the supply chain. Following IATF 16949 edition in 2016, certificates to ISO/TS 16949:2009 will no longer be valid after 14th September 2018 [9].

The automotive suppliers' proportion of value added to worldwide automobile manufacture shows a consistent growth, from 56% in 1985 to 82% in 2015 [10]. QMS are a key requirement to ensure a competent supplier network, with properly selected and qualified suppliers [11] aiming for customer satisfaction, lean processes, and defect free products. Due to the highly complex and global automotive industry supply chain, QMS has been a key topic in the study of supply-chain management in the automotive industry [12].

This research goal is to access if, for organizations that have been independently audited against ISO 9001:2015, there is a relationship between the way they identify their external and internal contexts, they change managing processes, and their capacity to effectively improve performance and results.

Considering that ISO 9001:2015 was released in September 2015, its time to access if organizations that properly identify their internal and external contexts, and have high change intensity, show higher improvement performance.

Since the new ISO 9001:2015 QMS International Standard, specifically requires organizations to address the internal and external context and to manage the change processes in a consistent and effective way, a study of the organizations that have already implemented and were   independently audited against ISO 9001:2015, was

performed with IRCA (International Register of Certificated Auditors) ISO 9001:2015 registered auditors, all over the world. The utilization of independent auditors or assessors, instead of quality managers, is likely to minimize risk bias, as reported in previous studies [13].

The conclusions highlight the need for the automotive industry OEM and Suppliers to properly monitor the organizational (internal and external) context and to identify the key issues that affect the ability of their QMS to deliver quality products, and to plan, design, implement and control change in an effective and timely manner, within the whole supply chain. The automotive industry supply chain spreads along many industries, such as steel, iron, aluminum, glass, plastics, glass, textiles, electronics, automation, and rubber and more. Although the audits performed by the surveyed Auditors encompassed all activity sectors, due to the horizontal characteristics of the automotive industry, this could be a valuable input for the industry ecosystem.

2. Methodology

The research started by reviewing the influence of suppliers in the automotive industry and taking into consideration the relevance of ISO 9001:2015 QMS for the industry, the following research questions were proposed:

- H1: Is there a positive correlation between the capability of organizations to understand the context and their ability to change?

- H2: Is there a positive correlation between the capability of organizations to understand the context and their ability to achieve improved performance and results?

- H3: Is there a positive correlation between the organizations' ability to change (plan, design, implement and control change) and the achievement of improved performance and results?

To ascertain the perceptions of credible and competent quality professionals on the successful implementation of ISO 9001:2015 requirements concerning, organizational context, change management and the achievement of improvement performance and results, an on-line survey was held among QMS ISO 9001 certified IRCA (International Register of Certificated Auditors) 5459 Auditors worldwide. The contacts were retrieved from the IRCA website (www.irca.org) and an email was sent asking to respond to an online survey. Although online surveys can generate low response rates when compared to other survey methods, they are a suitable technique to reach quickly, and at a low cost, a specified population that is geographically dispersed and used to online activity [14].

IRCA Registered QMS Auditors certification requires auditors to meet a qualification criterion based on work and auditing experience, and successful completion of IRCA Certified Training Course (http://www.irca.org). By using independent and external auditors, the possible bias of studies using perceptual data based on quality managers' opinions is minimized.

The survey started with several questions to characterize the respondents, followed by the questions presented in table 1, accessed with an agreement five-point scale (Do not agree at all (1), …, Totally agree (5):

Table 1. Survey questionnaire.

Question
P1: Based on your ISO 9001:2015 audit experience, do you agree that "Understanding the organization and its context" has been successfully implemented by the auditee organizations?
P2: Based on your ISO 9001:2015 audit experience, do you agree that "Change management" has been successfully implemented by the auditee organizations?
P3: Based on your ISO 9001:2015 audit experience, do you agree that "Improvement" has been successfully implemented by the auditee organizations?

A Likert five-point agreement scale (Do not agree at all (1), …, Totally agree (5)) was used to gather the auditors' feedback. Likert-type scales are used regularly, and their properties have been extensively reviewed, with scales using 5 or 7 scale points the most common [15]. The 5 points scale was adopted to allow comparability with previous research studies on ISO 9001:2015 application [16]. Statistical Package for Social Sciences 20 (SPSS) was

used for the statistical treatment of data. Sample normality was confirmed trough Kolmogorov-Smirnov test and the research questions were tested descriptive statistics and Pearson Correlation analysis.

3. Results and discussion

A total of 393 auditors' replies were collected (7,2% of the population) with the main contributors for the survey responses being Europe and East Asia and Pacific macro-regions and the USA, UK, and France as the top three countries, as presented in Fig.1(a) and (b):
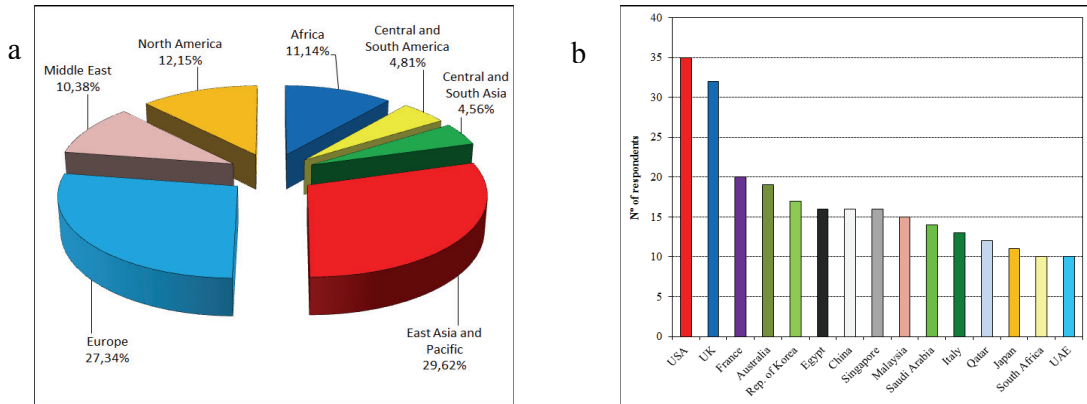

Fig. 1 Auditors responses breakdown by (a) Macro Regions; (b) Countries

The analysis of the sample profile indicates it matches the population and the results of the survey questionnaire yielded the following descriptive statistics as presented in table 2:

Table 2. Descriptive statistics

Statistics	P1 (context)	P2 (change)	P3 (improvement)
Valid N	299	298	299
Mean	3,1706	3,0268	3,1371
Median	3,0000	3,0000	3,0000
Mode	3,0000	3,0000	3,0000
Standard Deviation	0,91281	0,89100	1,01561

These results indicate that for QMS ISO 9001 certified IRCA Auditors, organizations have implemented in a positive way ISO 9001:2015 requirements concerned with organizational context, change processes, and improving performance, although some response variation is acknowledged. To access if there are differences between the responses from the world Macro Regions, the analysis of the Difference (in percent) of each Macro Region Average to the Rest of the World Average, for each one of the 3 survey questions was made and are presented in figures 2, 3 and 4 below:
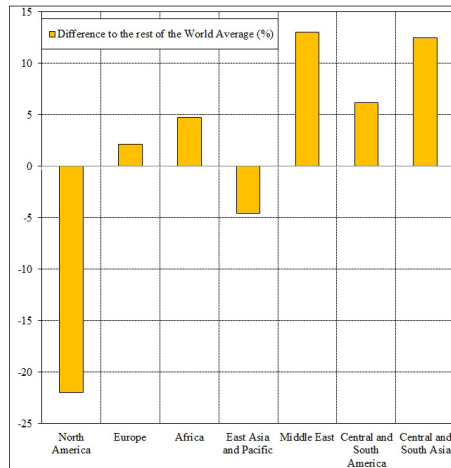
Fig. 2 Context: Difference (%) of each Macro Region Average to the Rest of the World Average
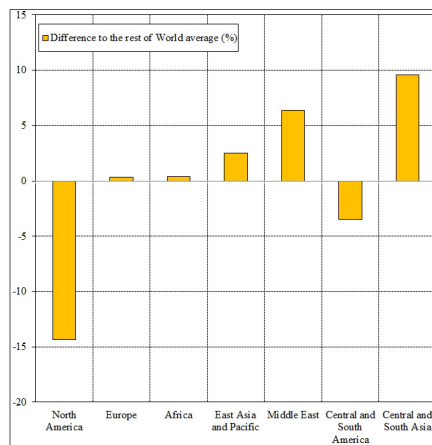

Fig.3 Change Management: Difference (%) of each Macro Region Average to the Rest of the World Average
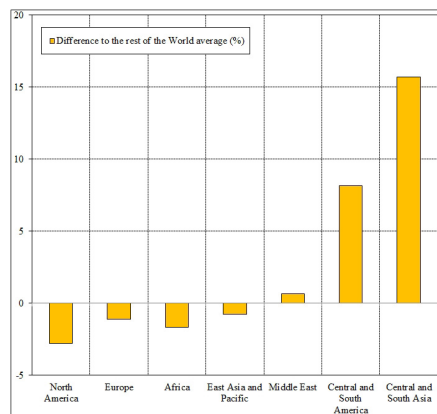

Fig.4 Improvement: Difference (%) of each Macro Region Average to the Rest of the World Average

These results highlight some differences between the macro World Regions. Central and South Asia show higher average values of performance in organizational context, change management and improvement, while North America presents significant lower scores on organizational context and improvement, and Europe stands near the average. This suggests further research concerning the adoption and implementation of ISO 9001:2015 in different world macro regions is advisable.

The normality of the samples was confirmed with Kolmogorov-Smirnov Test as presented in table 3:

Table 3. One-Sample Kolmogorov-Smirnov Test

Statistics	P1 (context)	P2 (change)	P3 (improvement)
N	299	298	299
Normal Parameters[a,b] Mean	3,1706	3,0268	3,1371
Normal Parameters[a,b] Std. Deviation	0,91281	0,89100	1,01561
Most Extreme Differences Absolute	0,233	0,227	0,203
Most Extreme Differences Positive	0,233	0,227	0,203
Most Extreme Differences Negative	-0,229	-0,233	-0,192
Test Statistic	0,223	0,227	0,203
Asymp. Sig. (2-tailed)	0,000[c]	0,000[c]	0,000[c]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

Since the data follows a normal distribution, Pearson correlation coefficient was used to access the relationship between the variables and the results are presented in table 4:

Table 4. Pearson correlations

Statistics	P1 (context)	P2 (change)	P3 (improvement)
P1 (context) Pearson Correlation	1	0,585**	0,558**
P1 Sig. (2 tailed)		0,000	0,000
N	299	295	294
P2 (change) Pearson Correlation	0,585**	1	0,617**
P2 Sig. (2-tailed)	0,000		0,000
N	295	298	293
P3 (improvement) Pearson Correlation	0,558**	0,617**	1
P3 Sig. (2-tailed)	0,000	0,000	
N	294	293	299

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

As is illustrated in Table 4, all the results show a positive high correlation between the analyzed variables since all correlations are significant at $(p<.001)$ (2-tailed). We can therefore statistically validate the hypothesis that there are positive linear relationships between P1(context) and P2 (change), between P1 (context) and P3 (improvement,) and between P2 (change) and P3 (improvement), if one variable increases, the other variable also increases.

4. Conclusions

The results of this research show the existence of a positive correlation between a) the capability to understanding the context and both the ability to change and the achievement of improved performance and results; b) the ability to change (plan, design, implement and control change) and the achievement of improved performance and results, validating Hypothesis 1, 2 and 3. The organizations that show a higher level of success in monitoring the environment and in managing change are the ones that also show a higher level of improvement, and the ability to change is the variable with the higher relationship with the achievement of organizational improvement.

The conclusions of this research highlight the need for OEM and their global supplier networks, to pay attention to the processes for plan, design, implement and control change, in an effective and timely manner, within the whole supply chain. In addition, the automotive industry OEM and Suppliers need to properly monitor the organizational (internal and external) context and identify the key issues that affect the ability of their QMS to deliver quality products.

Although the auditee organizations were not restricted to the automotive sector, due to the horizontal characteristics of the automotive industry supply chain, this could be a preliminary input of major contributors for the industry ecosystem improved performance and results.

The use qualified and independent auditors, on a worldwide basis, minimize the risk bias of other studies using quality managers as respondents. However, since the auditors' feedback was based on half a year of ISO 9001:2015 application, future continuous investigation, more focused in automotive industry sector organizations and QMS standards (such as the IATF 16949), and with the application of more additional statistical tools, could be performed to ascertain these conclusions.

Acknowledgements

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