

The impact of risk management process on supply chain performance: An exploratory case study in a beverage manufacturing organisation

N. Sukdeo

Department of Quality and Operations Management
University of Johannesburg
Gauteng, South Africa
nsukdeo@uj.ac.za

Abstract

There is increased recognition of supply chain management (SCM) by organisations globally, in order to gain a competitive advantage. The benefits of implementing a structured quality management system are well documented. The purpose of the study is to propose a logical approach to evaluating and managing risks in the supply chain. The investigation focused on an exploratory case study approach based in a beverage manufacturing organisation. The study investigates the impact of ISO 9001:2015 on supplier performance which leads to customer satisfaction and ultimately organisational performance. A pilot study was conducted as ISO 9001:2015 is a recently revised standard. The hypotheses were tested using a multiple regression analysis and it was found that there is a strong positive relationship between the predictor variables and dependent variables. The results of the regression analysis validates that supplier performance and customer satisfaction have a strong impact on organisation performance. A risk analysis was conducted using four phases of the risk management process and no critical risk factors were identified. Preventive measures and corrective action plans were implemented for risk factors with a medium to low rating.

Keywords

supply chain management, quality management systems, ISO 9001:2015, customer satisfaction

1. Introduction

The ISO 9001:2015 quality management system is designed to be adapted and applied across multiple sectors of the business environment (Norton, 2016). ISO 9001 was comprehensively reviewed in 2015 and the new requirements for compliance were introduced which included “risk-based thinking” (Chiarini, 2017 and Crute-Morris, 2016). It is not just an effective tool for improving processes, but also a reliable method for reducing associated costs and improving profit margins. ISO 9001 has been implemented to a great degree globally, by innumerable organisations, particularly in the manufacturing sector with the aim of improving the organisation’s performance and ensuring customer satisfaction (Gryna, Chua and DeFoe, 2015). At a time when global competition is extensively increasing and supply chains are becoming expanding and becoming more complex, the probability / likelihood of not achieving greater supplier performance is ever increasing as well, due to the risk of supply chain failure (Tummala and Schoenherr, 2011).

1.1 Objectives of the study

The main objective of the study is to investigate the impact of ISO 9001:2015 on supply chain performance in order to improve quality results through supplier relations, supplier evaluation and supplier-customer satisfaction.

1.2 Sub-objectives

- a) To determine the relationship between the risk management process and supplier performance.
- b) To determine the relationship between supplier performance and customer satisfaction.
- c) To determine the relationship between supplier and customer satisfaction on overall organisational performance.

The sub-objectives will be achieved through multiple regression analysis.

1.3 Theoretical framework of the study

Organisations need to recognise the supply chain interdependence, identify potential risk factors, their probability of occurring, and severity of the risk. Hertz and Thomas (1983), developed a structured risk management process (RMP), consisting of five phases which are risk identification, risk measurement, risk assessment, risk evaluation, risk control and monitoring. This RMP framework has come to be effectively applied to detect potential risks and to calculate the probability of occurrence. Therefore, the theoretical framework depicted in Fig. 1 was formulated by the researcher to form the basis of this study and consists of four phases.

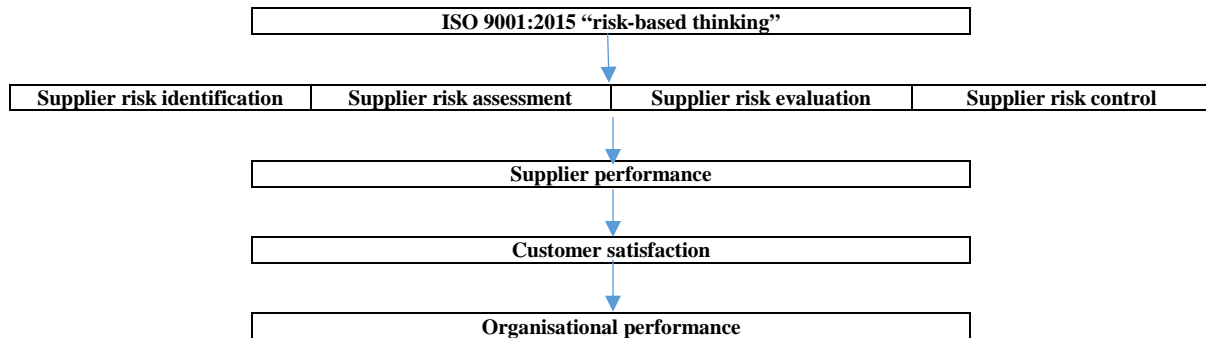


Figure 1 Theoretical Framework

1.4 Hypothesis

The following hypothesis were derived from the theoretical framework in Fig. 1:

- H₁: The four phases of risk management process has a significant positive relationship with supplier performance*
- H₂: Supplier performance has a significant positive relationship with customer satisfaction*
- H₃: Supplier performance and customer satisfaction has a significant positive relationship with organisational performance.*

2. Literature Review

2.1 Supply chain and quality management systems

Supply chain management (SCM) is an approach to integrating suppliers, manufacturers, distributors and retailers, such that products and services are manufactured and distributed in the correct quantities, to the correct locations, at the right time, with mutual goals of minimizing costs and satisfying customer requirements (Lin 2005). Therefore, SCM is a process-based approach to organisational performance improvement, which integrates supply chain processes created by upstream and downstream activities with a focus of generating value for all customers in the supply chain. A strategically implemented quality management system (QMS) within an organisation and across the supply chain can provide significant business results and increased improvement in product quality and ultimately customer satisfaction (Sroufe and Curkovic, 2008). According to a study by Fish (2011), it was found that there is a positive relationship between the implementation of a QMS and SCM. However, the supply chain is associated with

various types of risks. Therefore, the basis of this study was to conduct a risk analysis of the supply chain. ISO 9001:2015 has evolved from a process approach to a risk based approach (Prajogo, Huo and Han, 2012).

2.2 Risk based thinking

The need for risk based thinking is based on the following concept as identified by Deysher 2015:

- a) To improve customer confidence and satisfaction.
- b) To assure consistency of quality goods and services throughout the supply chain.
- c) To assure consistency of processes and procedures throughout the supply chain.
- d) To establish a proactive approach of prevention and improvements.

2.3 Supplier risk management process

The following steps were modified for the purpose of this study in Figure 1 above.

2.3.1 Supplier performance

The authors, Prahalad and Hamel (1990) and Qui and Tannock (2010) explain that quality management has been the key to globalisation of manufacturing and service industry for years. Some techniques have been adopted across the world, which have facilitated the supply chain of today, by raising the performance of suppliers. Customer satisfaction depends on supplier performance. In the past twenty years, supplier performance has played a very crucial role in the supply chain. This is due to suppliers being one of the major components of an organisation's policy and procedures (Bhatt and Huq, 2002). It was found that the drive of suppliers sharing information has a significant impact on their overall performance (Kannan and Tan, 2006). The result of good supplier performance can be determined through reliability, competence and cooperation. This performance essentially affects the quality of goods and services provided to customers, which in turn has an impact on organisational performance (Lascalles and Dale, 1989).

2.3.2 Customer satisfaction

Customer satisfaction is the overall attitude of customers towards a product or service after they have acquired and consumed it (Malhotra, 1999). During and after the use of a product or service, customers will develop feelings of satisfaction or dissatisfaction. Satisfaction or dissatisfaction levels are a function of the difference between perceived performance and expectation of a product or service (Kotler and Armstrong, 1996 and Stahl, 1999). It was found that the goal of satisfying customers is fundamental to quality management and that this goal can be achieved by an organisation's attempt to design and deliver products and services to fulfil customer needs. Therefore, quality management is a corporate state of mind that flourishes when the organisation is enthusiastic to change, to make decisions based on the primary goal of satisfying customer needs (Johnston and Weinstein, 2004). A quality management system allows organisations to obtain a great degree of differentiation, satisfying customer needs, and strengthening organisational performance (Crawford, 1990). Dramatic changes in the business environment has led to increased customer awareness of quality therefore many organisations have joined the quality initiative as a means to enhance competitiveness and customer satisfaction (Pande, Neuman and Cavanaugh, 2002).

2.3.3 Organisational performance

The successful implementation of quality management, will lead to numerous benefits such as reduction in costs, an improvement in product or service quality, an increased market shared and augmented customer satisfaction (Bricknell, 1996 and Chip, Reinecke and Spiller, 2004). The following quality management principles which is the foundation of ISO 9001:2015 are; customer focus, leadership, engagement of people, process approach, improvement, evidence-based decision making and relationship management. Therefore the focal point of this study was relationship management, directed at supplier relationship and performance, customer satisfaction and overall organisational performance.

3. Methodology

The study is based on an exploratory case study of a beverage manufacturing organisation. Triangulation is used a research method (Sarantakos, 1998). The type of triangulation that will be administered in this study will be methodological triangulation. This consequently represents the combination of the quantitative and qualitative research methods. The qualitative approach was used to identify supplier risks and the quantitative approach was the implementation of a risk register and analysis of the hypotheses. The risk register becomes vital as it records identified risks, their severity, and the action plans to be implemented. It can be a simple document, spreadsheet, or a database

system, but the most operational format is a tabulated risk register as indicated in Table 1 (Deysher, 2015). Therefore this study has adopted the triangulation research approach in which the quantitative results will supplement the qualitative results (Denzin and Lincoln, 2005). Regression analysis will be utilised to test the three hypotheses. This technique was utilised to analyse the relationship between a single dependent variable and several independent variables (Levine, Ramsay and Smidt, 2001).

3.1 Risk identification

The objective of risk identification is the frequent identification of events, if it occurs, it will have a negative impact on the supply chain. This involves a comprehensive resolve of potential supply chain risks associated with given problems (Tummala and Schoenherr, 2011). This is depicted in Table 4.

3.2 Risk assessment

The objective of risk assessment is the perseverance of the consequences of all potential supply chain risks as well as the calculation of their impact factor and the probability of each risk factor (Crockford, 1986). This is depicted in table 2. The probability factor of a risk occurring was rated on a scale from 1 to 10 and was calculated as follows:

- 1 to 4 – low probability
- 5 to 7 – medium probability
- 8 to 10 – high probability

The impact factor of the effect of the risk on the organisation, was rated on a scale of 1 to 10 and was calculated as follows:

- | | | | |
|---|----|-------------------|-----|
| 1 | to | 4 – low impact | (L) |
| 5 | to | 7 – medium impact | (M) |
| 8 | to | 10 – high impact | (H) |

3.3 Risk evaluation

The objective of risk evaluation is based on the calculation of the risk factor which leads to risk mitigation and contingency plans. This involves the development of action plans to contain and control risks after the evaluation stage (Tummala and Mak , 2001). This risk factor is represented in Table 7.

The following equation has been formulated to calculate risk factor:

Risk factor calculation: Probability (P) x Impact (I) = Risk factor

Therefore, risks with a factor value of less than 30 could be categorised as a *low* risk factor indicating minor risks, risks with a factor value of 31 to 70 could be categorised as a *medium* risk factor indicating major risks and risk with a factor value of more than 70 could be categorised as a *high* risk factor which indicates critical risks and should be prioritised in order of criticality.

3.4 Risk monitoring and control

Once the risk factors have been prioritised, corrective action can be implemented and preventive measures put in place in order to prevent future occurrences. The objective of risk monitoring and control is to examine the progress regarding the action plans and corrective action can be taken in achieving desired supply chain performance (Tummala and Schoenherr, 2011). This process is a means to determine possible preventive measures and to provide guidelines for further improvement to enhance organisational performance.

4. RESULTS

4.1 Analysis of hypothesis

H₁: The four phases of risk management process has a significant positive relationship with supplier performance

Table 1. Model of Hypothesis 1

R	R Square	Adjusted R Square	Std. Error of Estimate
0.770	0.602	0.552	0.56301

^a Predictors: Risk identification, risk assessment, risk evaluation, risk monitoring and control

^b Dependent variable: Supplier performance

The R value is 0.770 as shown in Table 1, this validates a strong dependent relationship and it elucidates 77.0% of the dependent variable i.e. supplier performance.

Table 2. Coefficients of dependent variable (supplier performance)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Supplier Performance (SP)	0.843	0.439		1.901	0.494
Risk identification	0.625	0.154	0.273	0.813	0.420
Risk assessment	0.654	0.156	0.163	1.692	0.326
Risk evaluation	0.667	0.154	0.258	1.737	0.488
Risk monitoring and control	0.608	0.143	0.146	0.998	

The regression analysis Table 2, identified the relationship between the predictors (four phases of risk management process) and the dependent variable SP. Utilising the results in Table 2, the estimated regression model is given in the following regression equation:

$$y(\text{SP}) = 0.843 + 0.625(x_1) + 0.654(x_2) + 0.667(x_3) + 0.608(x_4)$$

where

- SP = Supplier Performance
- x_i = relates to each element
- i = 1, 2, 3, 4
- x_1 = risk identification
- x_2 = risk assessment
- x_3 = risk evaluation
- x_4 = risk monitoring and control

The coefficient of determination (R^2) is an estimate of the percentage variation in the dependent variable (SP) which can be predicted from the independent variable (four phases of risk management process). This coefficient shows how well the multiple regression model fits the data. A value close to zero shows a weak fit whereas a value close to one implies a good fit. The R^2 – value of 0.602 in Table 2, indicates that 60.2% of the variation in SP can be explained by the four predictor variables identified in the regression equation. The larger beta (β) coefficient is 0.667, corresponding to risk evaluation (independent variable), which means that one standard deviation increase in risks evaluation is followed by 0.667 standard deviation increase in SP. It is evident that risk evaluation ($t = 1.737$) as well as risk assessment ($t = 1.692$) has a significant impact on the performance of suppliers as regular scheduled assessment and evaluation of suppliers leads to enhanced performance. Therefore, based on the above multiple regression analysis, the second hypothesis (H_1), is supported.

H_2 : Supplier performance has a significant positive relationship with customer satisfaction

Table 3. Model of Hypothesis 2

R	R Square	Adjusted R Square	Std. Error of Estimate
0.717	0.514	0.455	0.58019

^c Predictors: Supplier performance

^d Dependent variable: Customer satisfaction

The R value is 0.717 as shown in Table 3, this validates a strong dependent relationship and it elucidates 71.7% of the dependent variable i.e. customer satisfaction.

Table 4. Coefficients of the dependent variable (supplier performance)

<i>Constant</i>	<i>b</i>	<i>Std. Error</i>	β	<i>t</i>	<i>Sig.</i>
Customer satisfaction (CS)	0.759	0.427		1.702	0.094
Supplier performance	0.436	0.142	0.135	1.821	0.405

$$y(\text{CS}) = 0.759 + 0.436(x_1)$$

where CS = Customer Satisfaction
 x_i = relates to each element
 i = 1
 x_1 = supplier performance

The beta (β) coefficient is 0.436, corresponding to supplier performance (independent variable), which means that one standard deviation increase in supplier performance, is followed by 0.436 standard deviation increase in CS. It is evident that supplier performance ($t = 1.821$), has a significant impact on customer satisfaction. Therefore, based on the above multiple regression analysis, the H_2 , is supported.

H_3 : Supplier performance and customer satisfaction has a significant positive relationship with organisational performance.

Table 5. Model of Hypothesis 3

R	R Square	Adjusted R Square	Std. Error of Estimate
0.729	0.531	0.473	0.56708

^e Predictors: Supplier performance and customer satisfaction
^f Dependent variable: organisational performance

The R value is 0.729 as shown in Table 5, this validates a strong dependent relationship and it elucidates 72.9% of the dependent variable i.e. customer satisfaction.

Table 6. Coefficients of the dependent variable (organisational performance)

<i>Constant</i>	<i>b</i>	<i>Std. Error</i>	β	<i>t</i>	<i>Sig.</i>
Organisational Performance (OP)	0.832	0.167	0.298	1.741	0.088
Supplier performance	0.528	0.178	0.089	1.752	0.563
Customer satisfaction	0.569	0.140	0.060	1.791	0.811

$$y(\text{OP}) = 0.832 + 0.528(x_1) + 0.569(x_2)$$

where OP = Organisational Performance
 x_i = relates to each element
 i = 1, 2
 x_1 = supplier performance
 x_2 = customer satisfaction

The larger beta (β) coefficient is 0.569, corresponding to customer satisfaction (independent variable), which means that one standard deviation increase in customer satisfaction, is followed by 0.569 standard deviation increase in OP. It is evident that customer satisfaction ($t = 1.791$), has a significant impact on overall organisational performance. Therefore, based on the above multiple regression analysis, the H_3 , is supported.

Based on the four phases in the supply risk management process, a supply chain decision can be achieved. Management must validate their processes in order to justify any changes that have occurred in the business environment. The following sections show an in-depth analysis of each phase in the process.

4.2 Risk identification

Table 7 represents the risks which were identified by the beverage manufacturing organisation. These were the most common risks that occurred frequently. The researcher categorised the risks according to a study by Tummala and Schoenerr, (2011).

Table 7. Identified risks by the organisation

	<i>Demand risks</i>
1	Supplier nonconforming product or service or materials
2	Order fulfilment errors
3	Inaccurate forecasts on demand
	<i>Delay risks</i>
4	Processes are delayed due to insufficient or limited resources
5	Suppliers do not meet delivery deadlines
6	Breakdown of transport vehicles
	<i>Process risks</i>
7	High cost of production capacity
8	Change in product or service design
9	Lower product revenues
	<i>Disruption risks</i>
10	Labour disputes or strikes
11	Accidents and human errors
12	Natural disasters – floods, lightning strikes, disease, epidemics
	<i>Inventory risks</i>
13	Uncertainty of demand and supply
14	Obsolete products
15	Lack of supplier fulfilment
	<i>Systems risks</i>
16	Weak or ineffective control of supplier and customer systems, policies and procedures
17	Information and communication technology errors
18	Lack of compatibility of IT infrastructure among supply chain partners
	<i>Customer and competitor risks</i>
19	Competitor pricing
20	Lack of investment to sustain competitive advantage
21	Lack of customer requirements and satisfaction analysis

4.3 Risk assessment

Table 8 represents the calculation of the probability of each identified risk and the impact it would have on the organisation's performance. It is evident that for each risk which was identified, the probability of occurrence is between low and medium probability factors. The impact factors are slightly higher. This means that should the risk occur, it would affect supply chain performance and thereafter impact on organisational performance. These results ascertain that there is no high probability of occurrence as supply chain processes are monitored and controlled regularly throughout the supply chain of the beverage manufacturing organisation. However, due to uncertainties and an ever changing business environment, these risks could have a high probability and impact in future, if sound preventive measures are not implemented.

Table 8. Risk assessment

Item number	Probability (P)	Impact (I)
1	6	8
2	4	6
3	4	5
4	6	8

5	3	5
6	3	5
7	3	5
8	5	5
9	4	6
10	2	4
11	5	7
12	3	7
13	5	7
14	3	6
15	3	7
16	4	6
17	4	6
18	4	6
19	5	7
20	5	8
21	5	8

4.4 Risk evaluation

The results presented in Table 9 indicates that the beverage manufacturing organisation did not encounter any critical risks at the time of the study. However, it can be found that medium range risk factors which shows major risks, should be monitored and controlled strictly. These risks could be detrimental to the performance of suppliers and can impact on the service and products provided to customers and affect customer satisfaction. The results of the H_2 in Table 4, verifies that supplier performance is strongly related to customer satisfaction.

Table 9. Risk evaluation

Item number	Probability (P)	Impact (I)	Risk factor (P x I)	Low / Medium / High
1	6	8	48	M
2	4	6	24	L
3	4	5	20	L
4	6	8	48	M
5	3	5	15	L
6	3	5	15	L
7	3	5	15	L
8	5	5	25	L
9	4	6	24	L
10	2	4	8	L
11	5	7	35	M
12	3	7	21	L
13	5	7	35	M
14	3	6	18	L
15	3	7	21	L
16	4	6	24	L
17	4	6	24	L
18	4	6	24	L
19	5	7	35	M
20	5	8	40	M
21	5	8	40	M

4.5 Risk monitoring and control

The risk factors have been depicted as a chart, in order to monitor and control the highest factors and implement preventive measure for future non-occurrences. Fig. 2 shows that the highest factors are 48 at item numbers 1 and 4. These relate to non-conforming products and services from suppliers, and process delay due to insufficient resources, respectively. In order of priority, these factors should be addressed first and corrective action plans put in place. In this regard, supplier underwent a supplier audit to determine the reason for non-conformance. This is still under investigation as this was a pilot study which had been undertaken. The next highest factors are 40 at item numbers 20 and 21. These relates to the lack of sustaining a competitive advantage and lack of customer requirements analysis which leads to customer satisfaction, respectively. This can be attributed to item 1, in which supplier provide non-conforming products which lead to customer dissatisfaction. The following risk factors of item 11, 13 and 19 relates to accidents and human errors, uncertainty of demand and supply, and competitor pricing, respectively. These factors can have a huge impact on supplier performance and this affects organisational performance. Risk factors below 30 were not analysed in detail as it did not have a major impact on supplier and organisational performance.

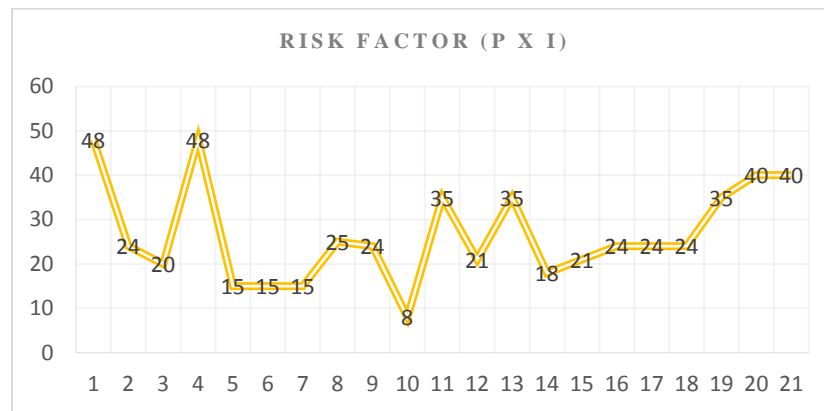


Figure 2. Risk monitoring and control

5. Conclusion

From an academic perspective, the study contributes a conceptual risk assessment framework. ISO 9001 confirms that the supplier organisation is robust and has effective systems deployed for the management of supplier and customer needs. The organisations should build on relationships with suppliers in order to maintain an effective and efficient quality management system. The results of the study shows that supplier who provide raw materials and items to organisations, significantly affect the quality of the final product and leads to customer satisfaction. The risk management process was an exploratory study conducted in order to evaluate the strengths and weaknesses of suppliers focusing on the risks associated within the supply chain. Poor supply chain performance could lead to poor quality of goods and services.

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Biography

Nita Sukdeo is currently a full time senior lecturer in the field of Quality and the BTech Quality programme leader in the Department of Quality and Operations Management, at the University of Johannesburg, Gauteng, South Africa. She obtained a Masters in Quality from the Durban University of Technology and a PhD in Engineering Management from the University of Johannesburg. She is an upcoming young researcher in the field of total quality management and operations management. Her field of expertise also include quantitative analysis, quality management systems and quality auditing. She is a qualified Lead Auditor, proficient in ISO standards and certification. She is a senior member of the South African Society for Quality (SASQ).

