A SUPPLIER RISK MATRIX APPROACH TO ISO 9001:2015 COMPLIANCE: A CASE STUDY

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Abstract

The revised ISO 9001:2015 quality management standard requires that organizations take a risk-based approach to operations within the scope of this accreditation. One important aspect of risk evaluation is the organization's supplier management process, as suppliers provide critical inputs impacting final product or service output integral to ISO Clause 8.4, "Control of Externally Provided Products and Services." The management of risk in supply chains has recently increased in importance, owing to several industry trends. To achieve accreditation and better manage their risks, organizations can benefit from a tool to categorize suppliers in terms of risk. Although the Supplier Positioning Matrix (also known as a Kraljic Matrix) relates the cost of purchasing to the total risk, it does not account for historical knowledge that organizations may have of their suppliers through previous relationships. This case study describes how the Kraljic Matrix was adapted by the

author and used by a defense contractor to classify suppliers in terms of risk and historical knowledge, thereby facilitating ISO 9001:2015 compliance and more robust supplier management practices.

Keywords: ISO 9001:2015, supplier risk, Kraljic Matrix, Supplier Positioning Matrix, supply chain risk management.

Data availability: The data used in this case study are owned by the client company and are not available publicly.

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INTRODUCTION

ISO 9001 is an international standard which specifies requirements for quality management systems (QMS). Organizations implement processes conforming to the requirements of the standard to demonstrate the ability to consistently provide products and services that meet stakeholder requirements (ISO, 2017). ISO 9001 was first published in 1987 by the International Organization for Standardization (ISO), an international agency composed of the national standards bodies of more than 160 countries (ISO, 2017). It is the most widely used standard of the ISO series (Medic, 2016), with over one million companies and organizations in over 170 countries certified to the ISO 9001 standard (ISO, 2017).

The current version of ISO 9001 was released in September 2015. The changes introduced in the 2015 revision were intended to ensure that ISO 9001 continues to adapt to the changing environments in which organizations operate. Some of the key updates in ISO 9001:2015 include restructuring some of the information from the previous 2008 version; emphasizing risk-based thinking to enhance the application of the process approach; improved applicability for services; and increased leadership requirements (Medic, 2016). Risk and risk-based thinking are noted nine times in ISO 9001:2015 (Kymal and Reid, 2015).

One important mention of risk is in Clause 8.4, “Control of Externally Provided Products and Services.” However, the standard is appropriately silent on the mechanism by which an organization should achieve risk-based thinking in any of the standard’s clauses. Thus, it is the responsibility of the organization seeking certification to develop such a mechanism (Kymal and Reid, 2015). As the ISO 9001:2008 Quality Management System (QMS) standard will be obsolete on September 14, 2018 (Preparing for the Change, 2015), organizations might benefit from having a tool that can be readily adapted to evaluate supplier risk. To develop that tool, an understanding of risk is warranted, along with an understanding of what tools currently exist.

LITERATURE REVIEW

The literature review will have two foci. The first is an overview of risk as a business concept, with particular attention to its definition within ISO 9001:2015. The second is a discussion of risk matrices as a possible tool for ISO 9001:2015 compliance.

The Role of Risk

Supply chain risk has become increasingly important because of several industry trends, including increases in strategic outsourcing by firms, increased market globalization, increasing reliance on supplier specialized capabilities and innovation, use of supply networks to achieve competitive advantage, and growing information technologies (Moeinzadeh and Hajfathaliha, 2009). These trends offer opportunities to organizations but also potential problems, as global organizational engagement increases the probability of negative events. Thus, risk and risk management are common terms in today’s business environment (Ritchie & Brindley, 2007).

Ritchie and Brindley (2007) remind us that the notion of risk is not a new problem for production, service, and retailers, resulting in management

actions aimed at improving opportunities and addressing risks at all levels of the organization, including routine, operational, and strategic levels (Christopher & Lee, 2004). This idea is supported by Moeinzadeh and Hajfathaliha (2009), who agree that the true goal of supply chain risk management is to make decisions that are aligned with processes to maximize opportunities while also minimizing risk. Christopher and Lee (2004) argue that risk in the supply chain can be exacerbated by many unanticipated disruptions. Indeed, such disruptions are not just limited to major incidents such as an earthquake, but also events such as labor strikes. Thus, disruptions can manifest anywhere in the supply chain (Moeinzadeh & Hajfathaliha, 2009). The need for an effective way to anticipate, identify, and classify risk in supply chains is apparent (Narasimhan & Talluri, 2009).

Risk can be complicated to define, and how an organization defines risk is subject to the context in which activities occur (Moeinzadeh and Hajfathaliha, 2009). ISO 9001:2015 defines risk as “the effect of uncertainty” (Kymal & Reid, 2015). Further, the standard later describes risk as a deviation from the expected, expressed as the likelihood of occurrence and resulting consequences (Kymal & Reid, 2015). Thus, the ISO’s ambiguous definition allows each organization to describe risk for itself.

An Existing Tool for Risk

Risk matrices are used by many organizations to rank and prioritize risks to aid in decision-making (Allen, 2013). Structurally, a risk matrix uses two distinct dimensions described typically in categorical terms, such as “consequence” and “likelihood of occurrence.” The two dimensions are graphically presented as vertical and horizontal axes. For example, the “consequence” axis might include “no consequence,” “moderate damage,” “severe damage,” and “catastrophic.” “Likelihood of occurrence” might be described as “remote,” “seldom,” “frequently,” or “always.” These dimensions are combined and mapped to a limited number of

risk categories, with each category conveying a sense of the activities necessary to address the situation being evaluated (Allen, 2013).

Risk matrices generally are used for two purposes (Duijm, 2015). The first application is to assist in decision-making for a particular issue. For example, an issue might have minor enough consequences and frequency to lead the decision-makers to assume the risk. The second application is to prioritize risk so that the riskiest issues are addressed with greater expediency and resources. This application is helpful when attempting to manage risk with finite resources, a concern common to all organizations (Walters & Barneva, 2017).

Three levels of risk are typically denoted (Duijm, 2015). These include hazards (often noted in red), intermediate (yellow), and broadly acceptable (green). In the first application of a risk matrix, a hazard would require more extensive corrective action than an issue designated as intermediate or broadly acceptable. For example, in a hazardous condition, one might choose to avoid the risk and take actions to achieve that goal. Intermediate levels might warrant a transfer or mitigation of risk, while a broadly acceptable level might result in accepting the risk (Duijm, 2015).

In the second application of a risk matrix (prioritizing), the actual combinations of characteristics might be numbered with varying risk levels, which represent the priority of risk management activities. In this application, it may be necessary to go beyond the three levels of risk described above to obtain enough resolution so that events are not all assigned the same risk. Even so, different events may still result in the same assigned risk (Duijm, 2015).

Using a risk matrix is not a panacea for making decisions regarding risk ("Risk Matrices," 2017). It will, however, allow the user to understand which events are more important than others. This understanding will allow management to determine the best course of actions, if any, to take to deal with the risk.

A risk matrix can be used to assist an organization in evaluating a worst-case scenario, the current situation, and the future situation ("Risk Matrices," 2017). In a worst-case scenario, the organization develops what-ifs for potential events, without any consideration of current protections; the prioritization for that event is then determined. The current situation considers the event in terms of existing processes. Here, any protections are considered. The future situation allows the organization to project improvements in the risk level after improvements are made.

A matrix currently used in operations management to strategically position suppliers is the Supplier Positioning Matrix (also known as a Kraljic Matrix, after its author). Developed in 1983, this technique originally employed a 2 x 2 matrix, with high and low assignments for each dimension. The first dimension is supply vulnerability, which is described as the organizational impact if a supplier fails or a supply disappears. Supply vulnerability might include three conditions: 1) Does the supplier have access to the buyer's infrastructure? 2) Are there many suppliers of this supply? and 3) Is the supply indispensable to the buyer's business? (Simpson & Hancock, 2012). The ability of the supplier to access the buyer's infrastructure can be as direct as having offices on the premises or as indirect as having access to information systems. Alternative suppliers imply that if a supply cannot be obtained from a preferred supplier, it may be obtained elsewhere. Indispensability to the buyer's business means that if the supply were not available (regardless of supplier), work would have to stop immediately.

The second dimension is concerned with the amount of money paid to a supplier on an annual basis (Supply Chain News, 2010). This results in a four-quadrant tool, with each quadrant representing a relationship strategy for the management of that supplier.

The bottom left quadrant of the Supplier Positioning Matrix represents an acquisition relationship strategy, determined by these purchases being both low value and low risk. Here, an organization should not expend a great deal of time or energy in purchasing; the supplies should simply be

acquired. The bottom right quadrant is the profit category, as quite a bit of money is spent on these supplies, but vulnerability is low; as a result, the buyer should leverage its purchasing power when making purchases within this quadrant. Purchases in the top left quadrant are of low value, but high risk. As a result, continuity of supply is critical. This quadrant is designated as a security relationship strategy. Those purchases that are both high expenditures with high risk—the top right quadrant—require critical relationship strategies. The organization should focus most of its effort to make purchasing decisions here (Simpson & Hancock, 2012).

Refinements, including by Kraljic, have been made to the Supplier Positioning Matrix (Supply Chain News, 2010). However, the model continues to be criticized (Supply Chain News, 2010), particularly its focus on risk to the exclusion of supplier performance and other dimensions as well as its neglect of the suppliers' perceptions of the buyer.

In conclusion, matrices provide a means by which organizations might manage prioritization of risk and subsequent decisions in terms of that risk. The Supplier Positioning Matrix may serve as a tool that incorporates risk in terms of supplies. But the Supplier Positioning Matrix does not account for historical knowledge of suppliers in terms of supplier performance. As a result, no single tool currently exists that allows risk to be judged in terms of historical performance, which would provide a more robust means of evaluating risk in suppliers.

PURPOSE AND RESEARCH QUESTIONS

The purpose of this study is to develop a risk management tool for organizations seeking ISO 9001:2015 that may be used to judge supplier risk in terms of historical knowledge of suppliers and conditions of supplier vulnerability.

To meet this purpose, three research questions will be considered.

Research Question 1

Can a supplier risk matrix be constructed based on the Kraljic Matrix, incorporating historical supplier performance?

Research Question 2

Would the developed tool from Research Question 1 provide enough discrimination among the slate of an organization's suppliers to facilitate appropriate risk management?

Research Question 3

Would the developed tool, once implemented, be viewed as facilitating ISO 9001:2015 compliance for the ISO clause "Control of Externally Provided Products and Services"?

METHODOLOGY

To answer these research questions, the author partnered with a defense contractor that was transitioning to ISO 9001:2015. To protect its market presence, and given the nature of its work, this organization will remain anonymous. The research questions were addressed using a mixed-methods approach incorporating both qualitative and quantitative data.

To answer Research Question 1, five members of the partnering organization representing executive levels of leadership in Quality and Operations, along with this study's author, evaluated three years of historical supplier performance data for its current supplier base to identify trends or similarities among performance. If a supplier did not have three years of data available, the available data were evaluated. Emergent similarities were described as specific categories to be incorporated into the matrix as the vertical axis.

The team determined the horizontal axis by adapting established information from secondary research, specifically the Kraljic Matrix. The team then discussed how to apply the risk conditions posed by the Kraljic

Matrix in a manner complementary to the vertical axis, i.e., a similar number of categories and conditions.

Team members individually assigned risk-level criticalities to each cell of the matrix and then met to reach consensus on the assignments. They also devised a color scheme for the matrix that would communicate the appropriate level of action for the varied risk criticality levels.

To answer Research Question 2, the team reviewed its current supplier base and assigned risk-level criticalities for each supplier in terms of its supplied service/product. The matrix would be deemed to have sufficient discrimination to facilitate risk management if the results demonstrated a dispersed assignment of risk-level criticality. For example, not all suppliers would be considered “hazardous” or “broadly acceptable.” Because of the nature of this organization’s business, it expected few suppliers to be in the hazardous range, and most to be in the broadly acceptable to intermediate range. The organization further anticipated few suppliers to be assigned the lowest level of risk criticality. This situation would be ideal, in that actions taken to manage the risk would be more feasible in terms of allocation of resources for supplier monitoring and management. A Pareto Analysis was used to analyze the data.

To answer Research Question 3, the team implemented the matrix and presented its use to the organization’s registrar during the organization’s ISO 9001:2015 transition audit. The matrix would be considered successful if no non-conformances were noted regarding the ISO clause “Control of Externally Provided Products and Services.”

RESULTS

The project was completed over a six-month timeframe. The results are below, with each research question considered independently.

Research Question 1: Can a supplier risk matrix be constructed based on the Kraljic Matrix, incorporating historical supplier performance?

To construct the matrix, existing suppliers to the organization participating in the study were evaluated. The historical performance of the suppliers in the business relationship was examined for the past three years or to the extent available. For example, in some cases, the supplier had only been used once.

The suppliers were grouped by performance into three categories:

- 1) Established suppliers with few to no problems;
- 2) Established, but requiring occasional to frequent corrective action requests; and
- 3) Limited business dealings resulting in limited data availability.

These categories reflect the progression of risk as less is known about the supplier or as the frequency of problems increases.

The team then attempted to objectively translate these categories. Suppliers considered to be “established with few to no problems” had a demonstrated pattern of use and rarely (approximately less than 5% of orders fulfilled) demonstrated any need to issue a corrective action request (CAR). A pattern of use implied that this supplier was the sole supplier considered when a specific material was ordered, but was not necessarily the sole supplier in the market.

Suppliers classified as being “established, but requiring occasional to frequent corrective action requests” had a demonstrated pattern of use; however, these suppliers more often required CARs than those in the preceding category, on more than 5% orders fulfilled. It should be noted that if the CAR frequency was too great, that supplier would not be maintained by the organization, as per its policy; however, if such a supplier was the sole supplier in the market, that supplier would be maintained until some other accommodation could occur.

Suppliers classified as “limited business dealings with limited data availability” might be comparatively new to the organization, with no demonstrated pattern of use. Thus, significant performance data were not available.

A last category was noted, indicating that a supplier's performance might be wholly unknown. This supplier would be new to the organization, and no data would be available to anticipate its performance.

These categories comprised the vertical axis of the risk matrix. The next step was to design the horizontal matrix. The Kraljic Matrix was used to structure this axis, with specific attention to three conditions (Simpson & Hancock 2012):

- 1) Does the supplier have access to the buyer's infrastructure?
- 2) Are there many suppliers of this supply?
- 3) Is the supply indispensable to the buyer's business?

These three conditions were considered critical because no matter what other vulnerabilities existed for a supplier, the most relevant risks were those that could directly impact the organization. For example, if a supplier was in a hurricane-prone area, the main concern from the organization's perspective was what impact that location would have. If the supply was not indispensable to the business or could be acquired elsewhere, the risk to the organization was lower.

To construct the horizontal axis, the team decided to simply count the critical conditions associated with a supplier by inquiring about each critical implication. Each affirmative response raised the risk's criticality, resulting in four levels:

- 1) Negligible; no critical implications noted.
- 2) Minor; one critical implication noted.
- 3) Major; two critical implications noted.
- 4) Critical; three critical implications noted.

By marrying the vertical axis to the horizontal axis, the foundation of the matrix is as shown in Figure 1: Foundation of Supplier Risk Matrix (see web appendix).

To operationalize Figure 1, the next step was to identify the risk criticality of each cell, resulting in 16 levels of risk criticality. The team began

by designating that the upper-right corner cell represented the highest risk criticality, while the lower-left corner cell represented the lowest. These were ranked as 16 and 1, respectively, with the higher number representing greater risk criticality. Participants then independently evaluated the remaining cells and assigned risk criticality numbers to them. After they completed this independent exercise, the participants compared results. Little discrepancy was noted among the results, with only one level of differences noted at the highest levels of criticality. The group discussed the discrepancies and eventually came to a consensus.

To complete the matrix, a three-level color coding system was created, with red representing hazardous risk criticality, yellow representing intermediate risk criticality, and green representing broadly acceptable risk criticality. As shown in Figure 2, this color scheme was assigned to cells of the completed supplier-risk matrix by team consensus, which is the final product of the exercise (see web appendix).

Research Question 2: Would the developed tool from Research Question 1 provide enough discrimination among the slate of an organization's suppliers to facilitate appropriate risk management?

The team reviewed its current supplier base and assigned risk-level criticalities for each supplier in terms of its supplied service/product. A total of 54 suppliers were evaluated. The resulting breakdown in terms of risk-level criticality is shown as Figure 3: Risk-Level Criticality for Existing Suppliers (see web appendix).

About 6% of suppliers were designated as having a risk-level criticality of hazardous, while about 61% were designated as broadly acceptable and just over 33% as intermediate. Only one supplier was considered to be at the lowest level of risk-level criticality, while no suppliers were at the highest level of risk.

Research Question 3: Would the developed tool, once implemented, be viewed as facilitating ISO 9001:2015 compliance for the ISO clause "Control of Externally Provided Products and Services"?

The organization underwent its ISO 9001:2015 transition audit in June of 2016, and the matrix and its results were presented as support for the ISO clause “Control of Externally Provided Products and Services.” The organization achieved certification to the new version of the standard, with no major or minor non-conformances noted.

DISCUSSION

This case study shows that it is feasible to develop a risk management tool for organizations seeking ISO 9001:2015 that may be used to judge supplier risk in terms of historical knowledge of suppliers and conditions of supplier vulnerability.

Consistent with Allen (2013), two dimensions were used to construct the matrix. By using the information provided by Simpson and Hancock (2012), the organization was able to devise a matrix that adapts the Kraljic conditions of risk while addressing historical supplier performance. Lastly, the work of Duijm (2015) provided a means to operationalize the matrix in terms of risk level, providing three distinct categories: hazardous, intermediate, and broadly acceptable. This further refinement is consistent with Syed (2010), who argues that improvements to the original Kraljic model have been made.

The utility of such a risk matrix is best described by Duijm (2015), who indicates two key applications: 1) how to manage existing situations and 2) how to prioritize actions. These applications are not mutually exclusive.

For example, for those suppliers with a hazardous risk level, the organization may allocate more resources to manage those suppliers, including routine supplier audits, supplier certification programming, and tight monitoring systems. Additionally, the organization may evaluate how to minimize or eliminate the conditions that led to the higher risk-level criticality designation. For example, if the supplier has access to the infrastructure, then the organization may seek ways to eliminate the access. If the hazardous designation is due to supplier performance, the

organization may partner with the supplier to trend issues within the corrective action requests and assist them in determining root causes and sustainable corrective actions.

Hazardous risk-level criticality may also result from a lack of knowledge about the supplier. Here the organization may wish to simply monitor the supplier until a robust data set is established, after initial supplier qualification. These approaches would be applicable to those suppliers designated as intermediate risk-level criticality as well. However, intermediate risk-level criticality suppliers may not warrant routine audits; additionally, monitoring might not be as heightened as it is for those companies with a higher designation. For those suppliers with broadly acceptable designations, monitoring may still be a valuable tool, but should be even less rigorous.

LIMITATIONS OF THE RESEARCH AND FURTHER STUDY

This research was limited by several constraints. Each will be discussed here.

First, this was a case study of only one organization. As a result, the validity of the matrix is not known. The matrix should be applied to a variety of organizations of varying sizes to ascertain if similar results are achieved. These organizations should vary in size and business model, such as service organizations, job shop manufacturing, batch manufacturing, and high-volume manufacturing. In this way, differences could perhaps be ascertained among these types of organizations.

Second, the team made several assumptions while constructing the matrix. The first assumption occurred when determining historical performance of the suppliers. Ambiguous terms such as “few,” “occasional,” “frequent,” and “limited” were used. However, it would be helpful to operationalize those terms so that they could be applied consistently by varying organizations. Here a study could focus on the historical performance dimension, with organizations asked to define such terms

in normalized expressions, such as corrective action requests issued as a percentage of orders.

A second assumption of the team was the organization's expectations for the dispersion of risk-level criticalities. Although the study supported the organization's assumption, it is unclear if such characteristic dispersion would exist in other organizations. As with the first limitation, the matrix should be applied to a variety of organizations of varying sizes and business models to ascertain if similar results are achieved. An analysis could be conducted that would provide dispersion characteristics across organizational types.

A third limitation of this study is that it did not have a mechanism to manage suppliers that provide more than one material or service to the organization. In this case study, one supplier supplied one product or service; however, this situation may not always be the case. Supplier performance may vary by product; further, some conditions, such as access to infrastructure, may also vary by product or service. Thus, in this matrix, a supplier may have more than one risk-level criticality.

Finally, the acceptability of the matrix is based on one registrar's audit. As such, the reproducibility of the auditor's assessment of the matrix is unknown. To address this limitation, the matrix should be applied at several organizations, with the results presented to various auditors at various registrars to determine favorability regarding ISO 9001:2015.

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WEB APPENDIX

A web appendix for this paper is available at: <https://dx.doi.org/10.15239/j.brcacadjb.2020.10.01.wa03>