Article

A Hybrid Supply Chain Risk Management Approach for Lean Green Performance Based on AHP, RCA and TRIZ: A Case Study

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Abstract: The purpose of this research work is to provide supply chain managers with a formal and generalizable approach that furnishes accurate guidelines to achieve a 2D performance integrating both Lean and Green. Despite the fact that several research works have been conducted in the framework of Lean and Green, at a conceptual level, the relationship between both paradigms is still ambiguous. Furthermore, the literature revealed a lack of relevant and generalizable approaches that explicitly demonstrate how to successfully implement Lean and Green in a relevant and integrated way. Since risks are the main obstacles disrupting performance, this research work addresses the identified gap by proposing a risk management approach (RMA) for Lean Green performance in a supply-chain context. Risk cannot be managed if not well-identified; hence, a rigorous literature investigation was conducted to define this concept in a supply-chain context. Later, risk was introduced into Lean and Green aspects. Subsequently, through a comprehensive review of previous risk identification studies, a novel classification of supply chain risks in a Lean Green context was provided. At a corporate level, risks often include several sources that cannot be treated at once. Therefore, a risk assessment analysis was performed, employing an analytic hierarchy process for its ease of use and broad adaptability. The output of this analysis provides visibility for an organization's position toward performance goals and underlines crucial risks to be addressed. The risk treatment process was upgraded in this approach to a detailed analysis that aims at investigating the root causes behind the prioritized risks. Deployment of the approach on a corporate level revealed that treating a risk may negatively affect treating another. Indeed, thinking Lean is not necessarily Green, which stands with the fact that Lean Green supply chain challenges may outstrip classic optimization methods and techniques; therefore, its management requires innovative approaches. Thereby, our findings support the applicability and efficiency of the Theory of Inventive Problem Solving (TRIZ) in this setting. Although the case study focused on a specific company, the developed framework can be customized to fit different cases.

Keywords: Lean; Green; supply chain risk management; AHP; RCA; TRIZ

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1. Introduction

Several businesses are reluctant to implement Lean Green because they either see it as challenging or have already failed to achieve it. This failure generally results from the misunderstanding of the philosophy behind both paradigms and the lack of a structured and comprehensive framework for Lean and Green [1]. Not only businesses but also some researchers show reticence toward the combination of Lean Green approaches since Lean can have different objectives from Green, which questions the profitability of Lean practices when implementing Green practices [2]. With the growing pressure of society,

government, and customers regarding the environmental footprint caused by the growing industrialization and associated operations, Lean supply chain managers have been seeking a successful Green implementation in a way that maintains harmony. It is no longer a choice but an obligation to guarantee their sustainability.

Lean can be a significant mainstay to achieve Green goals in terms of cost and waste minimization, carbon footprint reduction, and enhancement of brand image, cost saving, and environmental responsibility with respect to transportation [3]. Lean production contributes to emissions reduction and pollution prevention as it is associated with greater reduction of resources [4]. The use of Lean manufacturing improves environmental impacts [5]. Coordinating Lean and Green can bring up several benefits such as improving the process flow, reducing lead times, costs, and regulatory non-compliance risk, improving environmental quality and employee morale and commitment, and also meeting customer expectations [6]. The results of the study conducted in [7] revealed a high correlation of Lean and Green, proving that bi-dimensional performance (integrating Lean and Green) outcome is greater than the sole one (integrating only Lean). Outcomes of the case studies conducted in [8,9] support that Lean and Green supply chain practices are positively associated.

Lean leads to Green, but Green thinking is not necessarily thinking Lean [10]. Lean management can act as a positive catalyzer for environmental performance; nevertheless, at a higher level, its implementation requires a significant commitment of resources, which can divert attention from environmental initiatives [11]. Some Lean aspects and practices are environmentally benign while others are not. Lean practices like respect for people and *jidoka* help to improve environmental performance while just-in-time (JIT) tools and practices are not necessarily eco-friendly [12]. Just-in-time practice promotes pollution, congestion, and increasing energy and space consumption [13], as well as generation of emissions [14]. Additionally, supply chain variables (plant size, sector, distances) influence how Lean practices will be in line with Green practices. For instance, inventories reduction abets emissions reduction, but when the distance increases in the supply chain, the frequency of replenishment (transportation) increases, which promotes generating carbon dioxide emissions; hence, Lean and Green can be in conflict [15].

The relationship between Lean and Green aspects and practices switches from convergence to antagonism, which highlights the need for an approach that combines both paradigms in a successful way. In the framework of the lean-green combination, the literature emphasizes two categories: autonomous and Lean-based approaches [2]. Within the first category, researchers suggest combining both paradigms in a stand-alone approach. In this context, several Lean-Green parallel/simultaneous models had been developed. These models are generally based on waste management techniques such as waste-reducing techniques (WRT) [16], six sigma and DMAIC [17], and advanced 3R (reduction, reuse, recovery) [18]. Within the second category, researchers proposed to use Lean as a catalyst for the implementation of Green practices through benefiting from the flexibility and adaptability of Lean practices [2]. In this frame, several Lean-Green sequential models had been developed that are generally based on the Value Stream Mapping (VSM) tool [19,20]. Lean approaches such as Kaizen have also been used in this framework [21].

Lean-based approaches require mastery of Lean tools and techniques for high efficiency. Thereby, these methods are not convenient for environments that are not adopting or at least familiar enough with Lean philosophy. On the other hand, both categories of Lean-Green combining approaches utilize generic problem solving as well as performance improvement methods. These methods are effective when seeking a 1D performance but not suitable for a 2D performance. This comes down to the fact that the tools used by these methods are difficult to apply when it comes to a multi-dimensional performance, which seeks to find solutions to potential contradictions instead of tradeoffs. Furthermore, there is a lack of conceptual approaches that combine Lean and Green in the literature since the existing ones are customized in order to complete companies' needs and variables (policies, local culture, and regulations) [2].

The gaps above spotlight the fact that despite the existing attempts, “how to successfully implement Lean and Green in the supply chain in a relevant and integrated way” remains unclear. Hence, the main goal of this research work is to provide supply chain managers with a formal and generalizable approach that provides guidelines that allow achieving a 2D performance regardless of the level of adoption of both Lean and Green philosophies.

As risks are often responsible for performance failure, we hypothesize that a risk management approach (RMA) could be a relevant solution to disclose ambiguity and address the research gaps above. Risk management is defined by the coordination of activities with a view to control and direct an organization regarding risk. This process takes part in leadership and governance and contributes to management systems’ improvement. Furthermore, managing risk takes into consideration the internal and external context of an organization, including cultural factors and human behaviors, and it takes part in all associated activities. Risk management also includes the interaction with stakeholders [22]. These aspects are absent for the proposed approaches in the literature. Supply chain risk management aims at recognizing and preventing (with appropriate actions) SC’s potential uncertainties. Four basic categories construct SCRM: risk sources, risk drivers, risk consequences, and risk mitigation strategies [23].

The aim of this study is to verify the previous hypothesis. In this context, secondary research questions will be addressed:

- ✓ How to introduce the concept of risk into Lean and Green aspects?
- ✓ How to identify, assess, prioritize, and treat these risks in the context of the Lean Green supply chain?
- ✓ How TRIZ can be applied to deal with potential conflicts that may arise in the context of risk treatment?

The remainder of this article is designed as follows. In the first section (Introduction), we presented a brief review of Lean and Green as well as the investigated relationships between both paradigms. In this section, we underlined the major gaps in previous attempts at a Lean–Green combination. By the end of the section, we presented the research problem we are going to tackle in the present work. In the second section (Supply Chain Risk in a Lean Green context), we define risk in the supply-chain context; then, we introduce this concept into Lean and Green aspects. In the third section (Materials and Methods), we exhibit in detail the steps and methods used to answer the research questions of the previous section. The fourth section of this paper (case study) shows in detail the deployment of the approach we propose at a corporate level. The last sections (Discussion and Conclusion) discuss findings, sum up the main results and contributions of the study, and underline its limitations.

2. Supply Chain Risk in a Lean Green Context

2.1. Risk in the Context of a Supply Chain

Risk is the effect (deviation from what is expected) of uncertainty on objectives, and it is expressed usually in terms of risk sources, potential events, their likelihood, and consequences [22]. In other words, risk is defined as the expected outcome of uncertain events [24]. The severity and probability of failing to achieve the desired results (outputs) of a process define risk [25]. In the supply-chain context, risks are unexpected and adverse events that may directly or indirectly cause disruption of the supply chain [26]. Probability, frequency, impact of losses, and speed are the most-discussed supply chain risk dimensions [24]. The literature provides different classifications of supply chain risks based on several criteria. From our review analysis, we were able to define the main risk categories that can cover all risk types that should be considered by any company in Figure 1.

Figure 1. Supply chain risks' classification.

2.1.1. Operational risks

a. Supply risk

Supply risk is defined by disappointing and or significant failures associated with inbound services and goods [27]. Supply risk is the likelihood that an incident occurs that leads to a firm's inability to meet customer requirements or threatening customer life and safety. These outcomes can arise from individual supplier failures or market characteristics [28].

b. Demand risk

Adverse events related to outbound flow that affects customer requirements (desired assortment and volume) and/or the probability of customers placing orders describe demand risk [29]. Demand risks can arise from poor supply chains, coordination and information sharing, forecasting errors, demand volatility, rationing and shortage rumors, and long-term horizons [30].

c. Process risks

Results of adverse events affecting the firm's profitability and ability to produce services and goods as well timeliness and quality of production [24].

d. Logistic risks

According to a review in [31], material flow creates logistic side risks that can emit from delivery delay, transportation complexity, a wrong choice of transportation mode, transportation infrastructure failure, supply-side constrictions or warehouse problems, improper packaging, cargo damage, natural disasters, labor disputes, and terrorist activities.

2.1.2. Financial Risks

Financial risks are threats that are likely to affect a financial firm's performance. These threats are associated with flows of cash among organizations, embedded costs, the incurrence of expenses and the use of investments for the entire network, accounts payable, settlements and accounts receivable, differing costs of capital and rates of expense incurrence, cash movements and settlements from one firm to the next, changes in currency exchange rates, and changes in accounting and tax laws [31].

2.1.3. Environmental Risks

Environmental risks are environmental potential impacts [32]. Environmental risks arise from supply chain disruption that may result from the changes in political environment and regulations, modification and renewal of laws, natural disasters, disease, epidemics, or international terror attacks, according to the investigation in [31].

2.1.4. Collaboration Risks

Collaboration risks are associated with the degree of cooperation of supply chain partners, which may give rise to several challenges such as decision-making complexity due to the variety of interests, cultures, and preferences of these partners [31].

2.1.5. Disruption risks

Disruption risks come from unexpected events that create changes in a system and disrupt normal activities. These risks can be classified into four major sections: Performance failure (supplier bankruptcy, accidents, poor quality controls, scheduling and routing failures, etc.), Force majeure (natural disasters, terrorism, economic disruptions, port closures, political instability, etc.), Inside job (contract breaches, fraudulent quality failures, equipment or product theft, worker strikes, intellectual property theft, etc.) and Disruptive strike (government bans and seizures, competitor litigations, targeted terrorism, piracy, hackers, theft, etc.) [33].

2.2. Supply Chain Risk Identification in Lean Green Context

As a risk expresses the deviation from what is expected, risks to be identified are aspects leading to Lean Green performance failure. These aspects are targets that both paradigms aim at reducing/eliminating. Lean aims at reducing wastes [34,35], classified in Table 1, reducing space and improving flexibility [36], avoiding talent waste and underutilization of skills [37], improving staff safety [34], and embracing a continuous improvement mentality [35]. Green seeks efficient energy [38] use, water use [39,40], and raw material use [6,37], reduction of emissions (to air, water, etc.) [41], reduction of solid wastes, scrap, rubbish, and others, as well as the reduction of hazardous wastes and process [41,42].

Table 1. Classification of Lean Japanese wastes [43].

Waste Type	Definition
Muda	Unsuitable processes and methods, unnecessary motion, unnecessary transport, overproduction, unnecessary stocks, waiting, non-quality
Mura	Variability, unevenness, inconsistency
Muri	Overburden

At a high level (strategic), Lean seeks performance (optimize cost and quality and maximize value) while Green searches for compliance with the regulations in force, improving the image of the company and distinguishing it from competitors. Both paradigms aim at responding to consumers' and stakeholders' desires. By adapting Lean Green (LG) performance goals into the classification in Figure 1, we could identify supply chain risks for LG performance in Table 2.

Table 2. Lean Green supply chain risks.

Risk Categories	Sub-Categories	Risks Associated with Lean Green Performance
Operational	Supply Risks	Delays, defects, inflexibility, variability, unethical practices, increased environmental footprint.
	Demand Risks	Delays, defects.
	Process Risks	Over-production, over-processing, defects, delays, inflexibility, variability.
	Logistic Risks	Useless transportation and displacements, useless motion, over-stocking, high space consumption (for storage and warehousing).
Financial	Financial Risks	All wastes can have a direct and or indirect impact on the financial situation through costs enhancement.
Environmental	Environmental risks	Excessive energy use, misuse of water, misuse of raw materials, emissions (to air, water, etc.), solid wastes, scrap, rubbish, and others, hazardous wastes, and process.
Collaboration	Collaboration risks	Overburden, talent waste and underutilization of skills, useless motion, resistance to changes.
Disruption	Disruption risks	Failed customers' and or shareholders' satisfaction, noncompliance with the regulations, being overtaken by competitiveness, accidents.

3. Materials and Methods

3.1. Methodology

With a view to fulfilling the research objectives and building a relevant supply chain risk management approach for Lean Green performance, we adopted steps in Figure 2 inspired from the RMA proposed by the British Standards ISO 31000 version 2018 [22]. The research method consisted of customizing these steps according to a Lean Green performance framework then conducting a real case study with an organization in order to assess the applicability of the developed approach.

Figure 2. Supply chain risk management process.

3.1.1. Step 1: Identification of the Context of the Study

In any risk management approach, decision makers/managers should be clear about the scope and relevant objectives to be considered. Then, risk types that align with the scope and objectives of the organization should be specified in order to customize the context of the study. In this step, we conducted a rigorous literature investigation on supply chain risks in order to provide a classification that aligns with the aim of this research work.

3.1.2. Step 2: Identification of Associated Risks

After defining the scope, risks that are likely to prevent the organization from achieving its objectives should be identified. The quality of each step of the supply chain risk management process affects the quality of the subsequent steps. Then, a poor identification of supply chain risks results in an inferior output of the SCRM process [30]. In this step, we identified and then classified risks associated with Lean Green performance according to the classification of the previous step.

3.1.3. Step 3: Risk Assessment

The aim behind this analysis is to reveal the nature of risks and their characteristics in order to help decision making about the urgency of treating them. The details and

complexity of this analysis depend highly on the availability and reliability of information about these risks [22]. In the framework of risk management, the literature provides several methods for risk assessment such as Pareto analysis, failure mode analysis, the likelihood–impact matrix, and others. The choice of an adequate method relies on risk criteria that decision makers/managers decide to include in the study. Since we took more than three criteria into consideration in our case study, we used the analytic hierarchy process (AHP), which is a multiple-criteria decision-making (MCDM) method. Risk scores obtained using the AHP allow target relevant risks to be prioritized.

3.1.4. Step 4: Risk Treatment

This step consists of proposing feasible solutions/strategies for addressing selected risks in the bottom of the step above. Virtually, the likelihood of these solutions being-conflicting is never zero, especially in the framework of Lean Green. Some statements in the introduction section highlight many cases where Lean and Green aspects can be antagonistic. Treating one risk may negatively influence another [44]; hence, in the present work, we managed to conduct a root causes analysis (RCA) to investigate at a micro-level common causes that may unfold the nature of relationships that may exist between risks. Then, we managed to extract action parameters associated with these causes with a view to investigating the impact of their values' variation on desired performance. This led us to the extraction of existing systems of contradictions and the use of the theory of inventive problem solving (TRIZ).

3.2. Analytic Hierarchy Process

Relative measurement is a theory in which decision makers are less interested in the exact measurement of quantities than the measurement of proportions between them [45]. This theory is well-suited when it comes to problems of choosing the best alternative. The analytic hierarchy process (AHP) is a methodology for relative measurement; its scope consists of rating alternatives through a pairwise comparison between them, compatible with relative measurement theory [45]. Thomas L. Saaty developed AHP theory from the lack of an easily understood, easy-to-implement, and common methodology that enables making complex decisions [46]. The analytic hierarchy process has found use in several domains due to its simplicity and proven power. AHP makes it easy to understand and subjectively analyze a problem through its hierarchical decomposition into sub-problems [46]. AHP is split into the steps below that we explain in detail according to [45,46].

3.2.1. Step 1: Building a Hierarchic Structure

Driving the decision-making process should include criteria that make an alternative preferable to others according to a specific goal. Then, at least a graphical formalism should be afforded in order to combine goals, criteria, and alternatives associated with the decision-making problem. A hierarchy serves this purpose in the AHP as it points out the relationship between elements of one level with others of the next lower level. This relationship permeates down to the lowest levels of the hierarchy, which makes each element connected to all the others, at least indirectly. Figure 3 exhibits a generic hierarchic structure $\forall p, k \in \mathbb{N}^* \setminus (1,2)$.

Figure 3. Generic hierarchic structure [46].

3.2.2. Step 2: Driving Pairwise Comparison Matrix

Experts or decision makers in general assign preferences to all levels of the hierarchical structure in a pairwise comparison of elements on a qualitative scale (see Table 3). The process starts with assigning preferences between criteria first, then between alternatives according to each criterion. Results of the comparison should be organized on a square matrix $A = (a_{ij})_{n \times n}$ whose diagonal elements are equal to 1. With a_{ij} = the degree of preference of one element X_i to another X_j such that $a_{ij} > 0$ and i express columns when j express rows ($i, j \in \mathbb{N}^*$). Each entry is supposed to approximate the ratio between two weights according to Saaty's theory:

$$a_{ij} \approx w_i/w_j \quad \forall i, j \quad (1)$$

Note that the (i, j) element of the matrix A is the reciprocal of the (j, i) element:

$$a_{ij} = 1/a_{ji} \quad \forall i, j \quad (2)$$

$$A = \begin{pmatrix} a_{11} & \cdots & a_{1j} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ a_{li} & \cdots & a_{ji} & \cdots & a_{ni} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ a_{ln} & \cdots & a_{jn} & \cdots & a_{nn} \end{pmatrix}$$

Table 3. Saaty's scale [45,46].

Definition of Importance	Associated Intensity
Equal importance	1
Weak importance of one over another	3
Essential or strong importance	5
Demonstrated importance	7
Absolute importance	9
Intermediate values between the two adjacent judgements	2,4,6,8

3.2.3. Step 3: Examining Consistency

The subjective nature of answers about comparisons may drive inconsistency that is tolerated by AHP at a certain level. Otherwise, if the consistency ratio CR fails, these answers should be revised.

$$CR = \frac{CI(A)}{RI_n} \quad (3)$$

with:

$$CI(A) = \frac{\lambda_{\max}(A) - n}{n - 1} \quad (4)$$

such that:

- CR: consistency ratio;
- CI: consistency index;
- RI_n : random index (see values in Table 4);
- $\lambda_{\max}$: the maximum eigenvalue of the matrix;
- n : matrix's order.

Table 4. Random index values for $n = (1, 2, \dots, 10)$ [45].

Matrix Order (n)	3	4	5	6	7	8	9	10
Value of RI_n	0.5247	0.8816	1.1086	1.2479	1.3417	1.4057	1.4499	1.4854

The consistency ratio CR should be less than 0.1 to claim that the matrix is consistent.

When $n > 10$, the random index can be calculated according to the following Equation (5) proposed in [47] such that λ is the least-square adjustment straight line.

$$RI_n = \frac{\lambda_{\max}(n) - n}{n - 1} \quad (5)$$

with

$$\lambda_{\max}(n) = 2.7699n - 4.3513 \quad (6)$$

3.2.4. Step 4: Calculating weight vectors

From each pairwise matrix, the decision maker should extract the associated weight vector W , which will serve to calculate the final score of each alternative. Several methods had been proposed to calculate the weight vector; in the present work, we choose the sum method, which is very common. Let $A = (a_{ij})_{n \times n}$ be the judgment matrix of order n , weight vector $W = (W_1, W_2, \dots, W_i, \dots, W_n)^T$, such that:

$$W_i = \frac{1}{n} \sum_{j=1}^n \frac{a_{ij}}{\sum_{k=1}^n a_{kj}}, \quad i = (1, 2, \dots, n) \quad (7)$$

3.2.5. Step 5: Scoring

Alternatives are classified according to their scores that are calculated using the following formula:

$$S_{alt_i} = \sum_{k=1}^m W_{Ck} * W_{alt_i/Ck}, \quad (i, m \in \mathbb{N}^*) \quad (8)$$

such that:

- S_{alt_i} : the score of an alternative i ;
- W_{Ck} : the weight of a criteria C_k ;
- $W_{alt_i/Ck}$: the weight of an alternative alt_i according to a criteria C_k .

3.3. TRIZ and the Concept of Contradictions

TRIZ (Teorija Reshenija Izobretateliskih Zadatch), the Russian acronym for the theory of inventive problem solving, is a combination of methods and tools that is based on several assumptions that are derived from dialectics and analysis regarding the evolution of technical systems. TRIZ does not impart solutions, yet it provides guidelines for that [48]. According to one of the TRIZ axioms, the evolution of technical systems can be through the identification and resolution of contradictions [49]. TRIZ defines two types of contradictions: physical contradictions (the direct opposition of two parameters formulated by one and the same system) and technical contradictions (a situation in which the improvement of a parameter A leads to the deterioration of a parameter B) [48]. Both parameters characterizing technical contradictions are labeled evaluation parameters, as they describe the problem to be solved, while the parameter describing the physical contradiction is labeled the action parameter, as it defines a way to act on the problematic situation [50]. TRIZ classical contradiction's system (Figure 4) is limited with more complex problems integrating several evaluation parameters [51]. A generalization of the model (Figure 5) has been defined to overcome this limitation [52]. The generalized model proposes generalized contradiction, whose structure is analogous to the classical TRIZ contradiction by replacing the parameters with concepts that define the logical combinations of values and variables. For the generalized physical contradiction, an action parameter turns into a set of action parameters, and values turn into concepts, while for the generalized technical contradiction, an evaluation parameter turns into a set of evaluation parameters.

- TC: Technical contradiction;
- GTC: Generalized technical contradiction.

Figure 4. Classical TRIZ system of contradiction [51].

Figure 5. Generalized TRIZ system of contradiction [51].

The resolution of classical physical contradictions can be performed through using separation principles, while the resolution of classical technical contradictions can be performed through using the matrix of 40 principles developed by Genrich Altshuller [53].

4. Case Study and Results

4.1. General Context (Presentation of the Case Study)

A food company based in Morocco produces a variety of products: de-bitter red and green olives, candied black olives, candied apricots, etc., and it is known for the good quality of its products. With the growing pressure of government and stakeholders regarding environmental issues, the company decided to go Green by taking into consideration environmental impacts in all its practices. As a first step of Green implementation, the managers decided to focus on the olives' supply chain. Since the investigation encompasses the whole process from supply to delivery, the scope fits with the classification in Figure 1.

4.2. Risk Identification

We identified risks in the Table 5; associated with the scope above, in accordance with the classification of Lean Green supply chain risks in Table 2.

Table 5. Risk sources associated with Lean Green performance.

Risk Categories	Risk Sources	ID
Supply risks	Delays in delivery	R1
	Poor quality of delivered products/defective products	R2
	Variability (in terms of desired quality) of delivered products	R3
	Obdurate supplier (flexibility issues)	R4
	Unethical supplier practices	R5
	Increased environmental footprint	R6
	Dependence on a single supplier	R7
	Fluctuations in suppliers' capacity	R8
	Lack of technical experience	R9
Demand risks	Customer complaints about delivery times	R10
	Customer complaints about quality	R11
Process risks	Overproduction (produce more features than requested by the customer)	R12
	Over-process (waste of time due to the unnecessary complexity of a process)	R13
	Contamination of finished products	R14
	Damaged packaging	R15
	Erroneous tickets	R16
	Presence of extraneous corps among the fruits	R17
	Presence of fruit particles or pits	R18
	Defective shape/texture	R19
	Defective color	R20
	Defective size	R21
	Lack of flexibility in the production chain	R22
	Variability	R23
	Bottlenecks	R24
	Low process capability	R25
Logistic risks	Insufficient transport means	R26
	Insufficient handling means	R27
	Unnecessary movements of handling equipment	R28
	Unnecessary movements of people	R2
	Insufficient space for storage	R30
	Over-stocking	R31
	Excessive consumption of surfaces for storage	R32
	Being out of stock/insufficient stock	R33
	Breakdowns/Breakdowns of transport equipment	R34
	Poor performance of logistics operations	R35
	Accidents	R36

Table 5. Cont.

Risk Categories	Risk Sources	ID
Financial risks	Price fluctuations	R37
	Increase in customs taxes	R38
	Exchange rates fluctuations	R39
	Economic changes	R40
	Late payments	R41
	Bankruptcy of clients	R42
	Concurrence	R43
Environmental risks	Excessive (more than expected) energy use	R44
	Excessive water use	R45
	Excessive use of natural resources	R46
	Excessive waste	R47
	Excessive emissions to air	R48
	Excessive emissions to water	R49
	Lack of upstream water treatment	R50
	No downstream water treatment (water used)	R51
Collaboration risks	Non-compliance with environmental standards	R52
	Overloading employees	R53
	Waste of talent and underutilization of skills	R54
	Resistance to change	R55
	Communication and information flow problems	R56
	Poor coordination	R57
Disruption risks	Accidents	R58
	Economic disruption	R59
	Port closure	R60
	Data hacking	R61
	Pirate attack	R62
	Loss of property	R63
	Serious accidents (fires, etc.)	R64

4.3. Risk Assessment

As described in the methodology section, we decided to use the analytic hierarchy process for risk assessment; results are deployed in the steps below.

4.3.1. Building Hierarchic Structure

In the present work, the main problem is risk prioritization when alternatives are associated with risks defined in Table 5. Based on the organization's available and reliable information about these risks (R1, . . . , R64), we decided to focus on the following criteria:

- C1: Frequency (occurrence of a risk);
- C2: Gravity (degree of damage that a risk can cause if it occurs);
- C3: Detectability (ability to detect risk's occurrence);
- C4: Degree of importance of a risk according to organization's policy.

The formalism of our decision-making problem is built in the graphic structure in Figure 6.

Figure 6. Hierarchic structure for the olives' supply chain.

4.3.2. Driving Pairwise Comparison Matrix

Assigning Preferences between Criteria:

The results of comparison between criteria resulted in the matrix below (A).

$$A = \begin{pmatrix} 1 & 1 & 2 & 2 \\ 1 & 1 & 2 & 2 \\ 1/2 & 1/2 & 1 & 1 \\ 1/2 & 1/2 & 1 & 1 \end{pmatrix}$$

Assigning Preferences between Alternatives According to Each Criterion:

After assigning preferences between criteria, in this section, we assign preferences between alternatives (risks (R1, ..., R64)) according to each criterion (C1, C2, C3, C4). Appendix A exhibits the pairwise comparison matrices of risks according to their: Frequency (C1) (see Tables A1–A3), Gravity (C2) (see Tables A4–A6), Detectability (C3) (see Tables A7–A9) and according to the Organization's policy (C4) (see Tables A10–A12).

4.3.3. Examining Consistency

The maximum eigenvalue $\lambda_{\max}$ of the matrix A is equal to 4, and its order n is equal to 4. Thus, according to Equations (3) and (4), the consistency ratio is equal to zero. The condition $CR < 0.1$ is verified; thus, the matrix A is consistent.

According to Equations (3)–(6) we calculated the consistency ratio (see Table 6). Results show that for all pairwise comparison matrixes, the $CR < 0.1$ which means that all of them are consistent. Note that we calculated values of $\lambda_{\max}$ and $\lambda_{\max}$ using RStudio software.

Table 6. Consistency ratio's measurement.

Criterion	$\lambda_{\max}$	CI	$\lambda_{\max}$	RIn	CR
Frequency	64.01322	0.000209841	172.9223	1.728925	0.000121
Gravity	64.33781	0.005362063	172.9223	1.728925	0.003101
Detectability	64.06327	0.001004286	172.9223	1.728925	0.000581
Policy	64.19932	0.00316381	172.9223	1.728925	0.00183

4.3.4. Calculating Weight Vectors

According to the sum method (see Equation (7)), we calculated the weight vectors of each comparison matrix.

$$WA = \begin{pmatrix} 1/3 \\ 1/3 \\ 1/6 \\ 1/6 \end{pmatrix}$$

- W_A : weigh vector associated with the matrix A of pairwise comparison between criteria;
- W_{C1} : weigh vector associated with the pairwise comparison matrix between risks ($R1, \dots, R64$) according to criterion C1, see Table A13 of Appendix B;
- W_{C2} : weigh vector associated with the pairwise comparison matrix between risks ($R1, \dots, R64$) according to criterion C2, see Table A13 of Appendix B;
- W_{C3} : weigh vector associated with the pairwise comparison matrix between risks ($R1, \dots, R64$) according to criterion C3, see Table A13 of Appendix B;
- W_{C4} : weigh vector associated with the pairwise comparison matrix between risks ($R1, \dots, R64$) according to criterion C4, see Table A13 of Appendix B.

The sum of the weights W_i composing each weight vector of the following: W_A , W_{C1} , W_{C2} , W_{C3} , and W_{C4} is equal to 1.

4.3.5. Scoring

The score S_{Ri} of each risk Ri is calculated according to Equation (8) as follows. Results of these calculations are presented in Table 7.

$$S_{Ri} = \sum_{k=1}^4 W_{Ck} * W_{Ri/Ck} \quad i = (1, \dots, 64)$$

$$S_{Ri} = (1/3 * W_{Ri/C1}) + (1/3 * W_{Ri/C2}) + (1/6 * W_{Ri/C3}) + (1/6 * W_{Ri/C4})$$

with:

- W_{Ck} : the weight of a criteria Ck ;
- $W_{Ri/Ck}$: the weight of an alternative Ri according to a criteria Ck .

Table 7. Risks' scores.

Risks	Scores	Risks	Scores
R18	0.03095	R24	0.014886
R34	0.027849	R21	0.013933
R43	0.025678	R57	0.013843
R14	0.023385	R59	0.013843
R44	0.022076	R6	0.013636
R45	0.022076	R8	0.013636
R36	0.02199	R13	0.013636
R58	0.021383	R29	0.013577
R42	0.021323	R32	0.013577
R33	0.020842	R16	0.013567
R10	0.020757	R60	0.013519
R27	0.019801	R62	0.013519
R30	0.019801	R48	0.012258
R17	0.019792	R54	0.011719
R37	0.019523	R55	0.011719
R41	0.019523	R4	0.011443
R9	0.019354	R22	0.011443
R64	0.019152	R3	0.011405
R49	0.018482	R26	0.011285
R11	0.018397	R31	0.011285
R12	0.018121	R47	0.011285
R56	0.017874	R20	0.01049
R7	0.017667	R50	0.010133
R38	0.017329	R52	0.010096
R39	0.017329	R51	0.010027
R40	0.017329	R53	0.009525
R1	0.015927	R19	0.009448
R25	0.015927	R2	0.009212
R35	0.01577	R15	0.008171
R61	0.015643	R28	0.008139
R63	0.015643	R5	0.007217
R23	0.014886	R46	0.006949

According to the distribution of risks presented in the graph above (Figure 7), we can see clearly that the difference between the majority of risks is small enough to consider that they are almost of equivalent importance excepting the outliers (R18—R34—R43). By examining the scores associated with each risk (Table 7) and looking at the graph, we can classify risks as follows in Table 8.

Figure 7. Risks' distribution according to their scores.

Table 8. Risks' classification.

Risks	Importance
R18—R34—R43	High
R14—R44—R45—R36—R58—R42—R33—R10—R27—R30—R17—R37—R41—R9—R64—R49—R11—R12—R56—R7—R38—R39—R40—R1—R25—R35—R61—R63—R23—R24—R21—R57—R59—R6—R8—R13—R29—R32—R16—R60—R62—R48	Moderate to low
R48—R54—R55—R4—R22—R3—R26—R31—R47—R20—R50—R52—R51—R53—R19—R2—R15—R28—R5—R46	Very low

4.4. Risk Treatment

This step is dedicated to proposing strategies/solutions for risks to be prioritized. Thereby, we are going to focus on the risk with the highest score, R18. Behind every problem lies causes that must be identified first and then eliminated. The solutions to be proposed for these causes should be able to prevent their redundancy [54]. Usually, several causes affecting each other at different levels are at the origin of the visible problem and can be classified according to [54] as follows:

- Symptoms (are signs of the problem that may seem as actual causes but are not);
- First-level causes (they directly lead to the problem);
- Higher-level causes (they lead to first-level causes and contribute indirectly to the problem through the cause-effect chain. Higher-level causes in the bottom of this chain are root causes).

Looking at what is hidden beneath the surface of problems by looking for root causes improves profitability and efficiency, as relying on quick fixes provokes the recurrence of tasks, which is time-, energy-, and resource-consuming. Root cause analysis (RCA) involves applying a series of common-sense techniques (5 Whys, cause and effect diagrams, also known as Fishbone diagrams, fault trees, check sheets) that are able to produce a documented, quantified, and systematic approach to identifying, understanding, and resolving underlying causes [55]. Figure 8 exhibits the results of our RCA on the risk R18.

Figure 8. Root causes analysis of R18.

We examined the importance of each of the root causes of R18 according to the company's data; details of this analysis are beyond the scope of this paper. It turned out that damages associated with storage modalities as well as damages caused by frictions are the most frequent causes to be taken into consideration.

4.4.1. Damages associated with storage modalities

Upstream storing has two types; the first one is handled in underground tanks where olives prepared for processing are stocked, while the second type concerns semi-processed olives that are stored in barrels.

For the First Type: Underground Tanks

Since storing volume and capacity are fixed, the bigger the order batch size, the more stress will be applied to the olives due to the increased number of fruits in each tank, which decreases their stability. This phenomenon gives rise to the system of contradiction below (Figure 9).

For the Second Type: Barrels

The number of barrels and available surface for storage are fixed; the bigger the semi-processed stock size, the more stress will be applied to the olives due to the increased number of fruits in each barrel, which decreases the olives' stability. This phenomenon gives rise to the system of contradiction below (Figure 10).

Figure 9. System of contradiction associated with the first storing type.

Figure 10. System of contradiction associated with the second storing type.

Resolution of Technical Contradictions

For both types, the parameter to improve is “stability” (parameter number 26 according to the table of generic engineering parameters), while the parameter that must not be degraded is “the quantity” (parameter number 13 according to the table of generic engineering parameters). According to the matrix for resolving technical contradictions developed by Altshuller, the following principles are proposed for resolution:

- TRIZ Principle 2: extraction—separation;
- TRIZ Principle 15: Dynamization—optimization;
- TRIZ Principle 17: Other dimension—change of dimension;
- TRIZ Principle 40: Composite materials or structures.

For the first type, we choose Principle 15 for the resolution of the technical contradiction of System 1. As a conceptual solution, we suggest integrating agitators or infiltrating compressed air into the tanks in order to avoid the settling of the olives, which will reduce the stress undergone by the olives’ weight (see Figure 11). Note that by red arrows we mean the stress applied to olives on the bottom of the tank, while black round arrows design olives’ movement due to agitation.

Figure 11. Solution 1.

While for the second type, we choose Principle 17 for the resolution of the technical contradiction of System 2. As a conceptual solution, we suggest overturning barrels with a view to reducing the stress exerted by the olives' weight (see Figure 12). Indeed, overturning barrels decreases stacked olives, which reduces the stress applied on fruits at the bottom. The spherical shape of the base also allows stress reduction.

Figure 12. Solution 2.

4.4.2. Damages caused by frictions between olives during agitation operations

Agitation is carried out in fixed volume basins for all types of treatment. Frictions occur when the distance is small between rotating olives in these basins. The action parameters responsible for this phenomenon are the number of olives in each basin and the air pressure that supplies it. The variability of these parameters influences not only the shape of the olive but also the homogeneity of the products at the end of the process as well as energy consumption and water consumption. The bigger the number of olives in a basin, the less space olives have to move in, which favors frictions and prevents chemicals from coating all fruits, which increases variability. In contrast, the lower quantities we have in a

basin, the more treatment cycles we will need, which increases delays. On the other hand, a high pressure of compressed air with a small number of olives allows spacing between fruits, which reduces variability and friction but increases energy consumption. According to these conclusions, which resulted from several experiments carried out by the company, we were able to extract the system of contradiction in Figure 13.

Figure 13. System of contradiction associated with damages caused by frictions.

5. Discussion

This research work develops a risk management approach (RMA) for Lean Green performance, responding to the lack of relevant approaches that combine both paradigms in a supply-chain context. A case study was introduced to demonstrate the applicability and relevance of the developed framework at a corporate level. Foremost, in this approach, we have driven a rigorous review analysis so as to define risks in the context of a supply chain. Later, we introduced this concept into Lean and Green aspects; then, we conducted a comprehensive literature review of risk identification studies. Thereby, we provided a novel supply chain risks' classification in which risk sources are associated with Lean Green performance goals. Subsequently, we introduced the analytic hierarchical process (AHP) for risk assessment with a view to detecting crucial risks to be prioritized. Indeed, at a corporate level, managers are often not able to treat all risk sources at once. Thus, criteria defining risks' importance should be identified to assist the decision-making process, which highlights the relevance of this step.

AHP provides a clear vision of the decision-making problem as it affords a hierarchic graphical formalism that combines the main goal with associated criteria and alternatives. These elements can be related to a tangible or intangible problem or even to an aspect of a decision. Additionally, the assessment of each element can be based on qualitative as well as quantitative data or even on judgments of the decision makers. Furthermore, AHP can include several criteria, which makes the assessment process more accurate. This flexibility provided by AHP is behind its applicability in several domains and ability to analyze complex decision-making problems. Our case study highlights these aspects as our problem criteria are inequivalent, and pairwise comparison was made according to different types of data. Deployment of AHP embodies its power and proves its applicability in a supply chain risk management framework.

In the case study, the results of the pairwise comparison revealed that the majority of risks are classified as moderate-to-low importance. At a macro-level, the situation seems stable and manageable, yet these risks can migrate in droves to a higher category (high importance risks) at any time, especially when risk scores are close. This migration will lead to performance failure; we therefore recommend that the company works on short-to medium-term strategies to mitigate these risks. As an output of this risk assessment

process, we could classify risks according to their importance, which provides visibility to the organization's position regarding its performance goals.

Proceeding to risk treatment, analyzing the root causes of the prioritized risk R18 led to the extraction of several systems of contradiction, which allowed us to describe all conflictual situations that may arise from it. Thereby, this analysis revealed the existence of correlations between some risks, which amounts to the existence of correlations between Lean and Green aspects. A big order batch size/a big semi-finished stock size covers companies' needs and increases their capability to respond to demand fluctuations; in return, it abets the degradation of olives' stability, which increases defects (see Figures 9 and 10). On the other hand, decreasing defects and variability requires reducing quantities of olives to be treated in each basin and providing high compressed air pressure, which induce increased delays, increased energy consumption, and increased water consumption (see Figure 13). This confirms that treating a risk may negatively influence the treatment of another.

In a summarized discussion of our findings, this study revealed that Lean thinking may indeed be antagonistic to Green thinking, which supports the fact that Lean Green supply chain challenges are more complex and outweigh classic optimization methods and techniques. Hence, LGSC management requires effective and innovative management approaches, which highlights the relevance of the theory of inventive problem solving's (TRIZ) integration. TRIZ helps to avoid psychological inertia and provides strong tools for guiding problem solving, which made the risk-treatment process time-saving and cost-saving. By integrating the theory of inventive problem solving, we proved its applicability to a supply chain risk management framework, especially in the context of Lean Green performance. Instead of looking for tradeoffs through classic optimization methods, we were able to propose innovative and adequate solutions that are able to resolve contradictions using TRIZ tools and techniques.

The literature distinguished two types of Lean–Green combination approaches: autonomous and Lean-based. The framework we developed in the present work aligns with the first category as it proposes a stand-alone approach. In contrast with Lean-based approaches, it affords necessary guidelines for managers that are not familiar with Lean techniques and practices. Unlike the other approaches, we utilized risk management philosophy instead of generic problem-solving and performance-improvement methods.

The first and second step of the risk management approach consist of framing the vision and defining risks associated with a specific context to be taken into consideration. These steps drive supply chain managers away from distractions that are likely to divert them from the project's main goal, as they provide necessary knowledge about the problem. Apart from a lack of expertise and poor culture about some specific techniques and concepts, performance failure generally comes from a poor identification of the real problem. Alongside this, risk identification can include aspects related to a multi-dimensional performance that outstrip the Lean–Green vision, which surpass the limitation highlighted in the introduction section about the previous attempts at a Lean–Green combination.

Subsequently to risk identification, risk assessment provides knowledge about the organization's position regarding its desired performance. Risk prioritization marks the starting point of the way to performance improvement as it gives prominence to risks with a high level of criticality. Thereby, the classification of risks supplies SC managers with a basis for improvement. The last step of this RMA was dedicated to providing suitable solutions for critical risk treatment. At a corporate level, the outputs of this step indirectly revealed the existing relationships between Lean aspects and Green aspects through examining the root causes of the prioritized risk. These results contribute to Lean Green map building and promote a better understanding of both paradigms' coexistence. Alongside this, these results underline that supply chain challenges require inventive solutions. By integrating the theory of inventive problem solving, our approach is able to outperform this challenge.

6. Conclusions

In the present work, we propose a hybrid risk management approach, which provides supply chain managers with guidelines for a successful Lean Green implementation. This approach stands out for its clarity, feasibility, and simplicity as it does not require mastery of practices and techniques related to Lean and Green. It is also cost-saving, time-saving, and labor-saving as it provides appropriate guidance, which minimizes the risk of performance failure. The approach also sticks out for its adaptability and flexibility, since the framework was conceptually developed independently of any corporate- or industrial-level specifications. Furthermore, this research work is the first to propose integrating risk management philosophy into Lean–Green combination projects.

The framework we developed responds to the gaps mentioned regarding previous attempts at a Lean–Green combination. However, some limitations remain. Our proposal lacks insights into risk monitoring guidelines for continuous improvement. From this perspective, we aim to lead further researches. Alongside this, the deployment of the approach was only tested at a corporate level. In this optic, we are aiming at assessing its applicability to an industrial level for different sectors of activity and more complex cases. Additionally, we are seeking as well to proceed to the resolution of the generalized system of contradiction in Figure 13.

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Abbreviations

TRIZ	Theory of inventive problem solving
LGSC	Lean Green Supply Chain
RMA	Risk management approach
SC	Supply Chain
TC	Technical Contradiction
GTC	Generalized Technical Contradiction

Appendix A

The following Appendixes (Appendices A and B) exhibit the pairwise comparison matrices we built in our case study and associated weight vectors. These data remain crucial to the research's reproduction.

Table A1. Pairwise comparison matrix between risks according to frequency, Part 1.

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21
R1	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R2	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4
R3	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4
R4	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R5	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4

Table A1. Cont.

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21
R6	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R7	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R8	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R9	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R9	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R10	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R11	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R12	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R13	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R14	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R15	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4
R16	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R17	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R18	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R19	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R20	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R21	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R22	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R23	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R24	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R25	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R26	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R27	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R28	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R29	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R30	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R31	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R32	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R33	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R34	2	6	6	4	6	4	4	4	4	2	4	2	4	4	6	4	4	2	4	4	2
R35	1	4	4	2	4	2	2	2	2	1	2	1	2	2	4	2	2	1	2	2	1
R36	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R37	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R38	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R39	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R40	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R41	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R42	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4
R43	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R44	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R45	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R46	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4
R47	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R48	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R49	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R50	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R51	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4
R52	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4
R53	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R54	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R55	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R56	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R57	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R58	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R59	1/2	2	2	1	2	1	1	1	1	1/2	1	1/2	1	1	2	1	1	1/2	1	1	1/2
R60	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4

Table A1. Cont.

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21
R61	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4
R62	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4
R63	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4
R64	1/4	1	1	1/2	1	1/2	1/2	1/2	1/2	1/4	1/2	1/4	1/2	1/2	1	1/2	1/2	1/4	1/2	1/2	1/4

Table A2. Pairwise comparison matrix between risks according to frequency, Part 2.

	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42
R1	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R2	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R3	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R4	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R5	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R6	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R7	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R8	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R9	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R10	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R11	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R12	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R13	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R14	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R15	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R16	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R17	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R18	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R19	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R20	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R21	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R22	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R23	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R24	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R25	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R26	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R27	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R28	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R29	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R30	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R31	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R32	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R33	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R34	4	2	2	2	4	2	4	2	2	4	2	2	1	2	4	4	4	4	4	4	6
R35	2	1	1	1	2	1	2	1	1	2	1	1	1/2	1	2	2	2	2	2	2	4
R36	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R37	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R38	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R39	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R40	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R41	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R42	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R43	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R44	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R45	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2

Table A2. Cont.

	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42
R46	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R47	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R48	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R49	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R50	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R51	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R52	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R53	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R54	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R55	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R56	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R57	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R58	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R59	1	1/2	1/2	1/2	1	1/2	1	1/2	1/2	1	1/2	1/2	1/4	1/2	1	1	1	1	1	1	2
R60	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R61	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R62	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R63	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1
R64	1/2	1/4	1/4	1/4	1/2	1/4	1/2	1/4	1/4	1/2	1/4	1/4	1/6	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1

Table A3. Pairwise comparison matrix between risks according to frequency, Part 3.

	R43	R44	R45	R46	R47	R48	R49	R50	R51	R52	R53	R54	R55	R56	R57	R58	R59	R60	R61	R62	R63	R64
R1	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R3	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R4	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R5	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R6	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R7	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R8	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R9	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R10	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R11	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R12	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R13	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R14	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R15	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R16	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R17	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R18	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R19	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R20	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R21	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R22	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R23	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R24	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R25	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R26	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R27	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R28	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R29	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R30	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4

Table A3. Cont.

	R43	R44	R45	R46	R47	R48	R49	R50	R51	R52	R53	R54	R55	R56	R57	R58	R59	R60	R61	R62	R63	R64
R31	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R32	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R33	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R34	4	4	4	6	4	4	4	4	6	6	4	4	4	4	4	4	4	6	6	6	6	6
R35	2	2	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	4	4
R36	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R37	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R38	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R39	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R40	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R41	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R42	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R43	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R44	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R45	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R46	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R47	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R48	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R49	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R50	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R51	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R52	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R53	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R54	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R55	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R56	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R57	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R58	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R59	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2
R60	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R61	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R62	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R63	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1
R64	1/2	1/2	1/2	1	1/2	1/2	1/2	1/2	1	1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1

Table A4. Pairwise comparison matrix between risks according to risks' gravity, Part 1.

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21
R1	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R2	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R3	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R4	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R5	1/2	1/2	1/4	1/2	1	1/4	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/2	1/2	1/6	1/8	1	1	1
R6	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R7	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R8	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R9	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R10	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R11	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R12	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R13	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R14	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R15	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2

Table A4. Cont.

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21
R16	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R17	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R18	6	6	4	6	8	4	2	4	4	4	4	4	4	2	6	6	2	1	8	8	8
R19	1/2	1/2	1/4	1/2	1	1/4	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/2	1/2	1/6	1/8	1	1	1
R20	1/2	1/2	1/4	1/2	1	1/4	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/2	1/2	1/6	1/8	1	1	1
R21	1/2	1/2	1/4	1/2	1	1/4	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/2	1/2	1/6	1/8	1	1	1
R22	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R23	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R24	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R25	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R26	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R27	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R28	1/2	1/2	1/4	1/2	1	1/4	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/2	1/2	1/6	1/8	1	1	1
R29	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R30	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R31	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R32	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R33	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R34	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R35	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R36	6	6	4	6	8	4	2	4	4	4	4	4	4	2	6	6	2	1	8	8	8
R37	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R38	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R39	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R40	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R41	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R42	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R43	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R44	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R45	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R46	1/2	1/2	1/4	1/2	1	1/4	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/2	1/2	1/6	1/8	1	1	1
R47	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R48	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R49	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R50	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R51	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R52	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R53	1	1	1/2	1	2	1/2	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1	1	1/4	1/6	2	2	2
R54	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R55	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R56	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R57	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R58	6	6	4	6	8	4	2	4	4	4	4	4	4	2	6	6	2	1	8	8	8
R59	2	2	1	2	4	1	1/2	1	1	1	1	1	1	1/2	2	2	1/2	1/4	4	4	4
R60	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R61	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R62	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R63	4	4	2	4	6	2	1	2	2	2	2	2	2	1	4	4	1	1/2	6	6	6
R64	6	6	4	6	8	4	2	4	4	4	4	4	4	2	6	6	2	1	8	8	8

Table A5. Pairwise comparison matrix between risks according to risks' gravity, Part 2.

	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42
R1	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R2	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R3	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2

Table A5. Cont.

	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42
R4	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R5	1/2	1/2	1/2	1/2	1/4	1/6	1	1/2	1/6	1/4	1/2	1/6	1/6	1/4	1/8	1/4	1/2	1/2	1/2	1/4	1/6
R6	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R7	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R8	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R9	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R10	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R11	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R12	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R13	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R14	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R15	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R16	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R17	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R18	6	6	6	6	4	2	8	6	2	4	6	2	2	4	1	4	6	6	6	4	2
R19	1/2	1/2	1/2	1/2	1/4	1/6	1	1/2	1/6	1/4	1/2	1/6	1/6	1/4	1/8	1/4	1/2	1/2	1/2	1/4	1/6
R20	1/2	1/2	1/2	1/2	1/4	1/6	1	1/2	1/6	1/4	1/2	1/6	1/6	1/4	1/8	1/4	1/2	1/2	1/2	1/4	1/6
R21	1/2	1/2	1/2	1/2	1/4	1/6	1	1/2	1/6	1/4	1/2	1/6	1/6	1/4	1/8	1/4	1/2	1/2	1/2	1/4	1/6
R22	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R23	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R24	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R25	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R26	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R27	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R28	1/2	1/2	1/2	1/2	1/4	1/6	1	1/2	1/6	1/4	1/2	1/6	1/6	1/4	1/8	1/4	1/2	1/2	1/2	1/4	1/6
R29	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R30	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R31	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R32	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R33	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R34	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R35	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R36	6	6	6	6	4	2	8	6	2	4	6	2	2	4	1	4	6	6	6	4	2
R37	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R38	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R39	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R40	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R41	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R42	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R43	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R44	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R45	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R46	1/2	1/2	1/2	1/2	1/4	1/6	1	1/2	1/6	1/4	1/2	1/6	1/6	1/4	1/8	1/4	1/2	1/2	1/2	1/4	1/6
R47	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R48	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R49	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R50	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R51	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R52	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R53	1	1	1	1	1/2	1/4	2	1	1/4	1/2	1	1/4	1/4	1/4	1/6	1/2	1	1	1	1/2	1/4
R54	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R55	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R56	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R57	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R58	6	6	6	6	4	2	8	6	2	4	6	2	2	4	1	4	6	6	6	4	2

Table A5. Cont.

	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42
R59	2	2	2	2	1	1/2	4	2	1/2	1	2	1/2	1/2	1	1/4	1	2	2	2	1	1/2
R60	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R61	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R62	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R63	4	4	4	4	2	1	6	4	1	2	4	1	1	2	1/2	2	4	4	4	2	1
R64	6	6	6	6	4	2	8	6	2	4	6	2	2	4	1	4	6	6	6	4	2

Table A6. Pairwise comparison matrix between risks according to risks' gravity, Part 3.

	R43	R44	R45	R46	R47	R48	R49	R50	R51	R52	R53	R54	R55	R56	R57	R58	R59	R60	R61	R62	R63	R64
R1	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R2	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R3	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R4	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R5	1/6	1/6	1/6	1	1/4	1/2	1/6	1/2	1/2	1/4	1/2	1/4	1/4	1/6	1/4	1/8	1/4	1/6	1/6	1/6	1/6	1/8
R6	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R7	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R8	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R9	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R10	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R11	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R12	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R13	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R14	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R15	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R16	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R17	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R18	2	2	2	8	4	6	2	6	6	4	6	4	4	2	4	1	4	2	2	2	2	1
R19	1/6	1/6	1/6	1	1/4	1/2	1/6	1/2	1/2	1/4	1/2	1/4	1/4	1/6	1/4	1/8	1/4	1/6	1/6	1/6	1/6	1/8
R20	1/6	1/6	1/6	1	1/4	1/2	1/6	1/2	1/2	1/4	1/2	1/4	1/4	1/6	1/4	1/8	1/4	1/6	1/6	1/6	1/6	1/8
R21	1/6	1/6	1/6	1	1/4	1/2	1/6	1/2	1/2	1/4	1/2	1/4	1/4	1/6	1/4	1/8	1/4	1/6	1/6	1/6	1/6	1/8
R22	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R23	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R24	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R25	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R26	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R27	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R28	1/6	1/6	1/6	1	1/4	1/2	1/6	1/2	1/2	1/4	1/2	1/4	1/4	1/6	1/4	1/8	1/4	1/6	1/6	1/6	1/6	1/8
R29	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R30	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R31	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R32	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R33	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R34	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R35	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R36	2	2	2	8	4	6	2	6	6	4	6	4	4	2	4	1	4	2	2	2	2	1
R37	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R38	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R39	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R40	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R41	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R42	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R43	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R44	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R45	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2

Table A6. Cont.

	R43	R44	R45	R46	R47	R48	R49	R50	R51	R52	R53	R54	R55	R56	R57	R58	R59	R60	R61	R62	R63	R64
R46	1/6	1/6	1/6	1	1/4	1/2	1/6	1/2	1/2	1/4	1/2	1/4	1/4	1/6	1/4	1/8	1/4	1/6	1/6	1/6	1/6	1/8
R47	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R48	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R49	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R50	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R51	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R52	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R53	1/4	1/4	1/4	2	1/2	1	1/4	1	1	1/2	1	1/2	1/2	1/4	1/2	1/6	1/2	1/4	1/4	1/4	1/4	1/6
R54	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R55	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R56	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R57	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R58	2	2	2	8	4	6	2	6	6	4	6	4	4	2	4	1	4	2	2	2	2	1
R59	1/2	1/2	1/2	4	1	2	1/2	2	2	1	2	1	1	1/2	1	1/4	1	1/2	1/2	1/2	1/2	1/2
R60	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R61	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R62	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R63	1	1	1	6	2	4	1	4	4	2	4	2	2	1	2	1/2	2	1	1	1	1	1/2
R64	2	2	2	8	4	6	2	6	6	4	6	4	4	2	4	1	4	2	2	2	2	1

Table A7. Pairwise comparison matrix between risks according to risks' detectability, Part 1.

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21
R1	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R2	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R3	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R4	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R5	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R6	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R7	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R8	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R9	4	4	4	4	6	4	4	4	1	4	2	4	4	1	6	2	2	2	6	4	6
R10	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R11	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R12	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R13	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R14	4	4	4	4	6	4	4	4	1	4	2	4	4	1	6	2	2	2	6	4	6
R15	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R16	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R17	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R18	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R19	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R20	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R21	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R22	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R23	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R24	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R25	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R26	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R27	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R28	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R29	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R30	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1

Table A7. Cont.

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21
R31	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R32	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R33	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R34	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R35	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R36	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R37	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R38	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R39	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R40	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R41	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R42	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R43	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R44	4	4	4	4	6	4	4	4	1	4	2	4	4	1	6	2	2	2	6	4	6
R45	4	4	4	4	6	4	4	4	1	4	2	4	4	1	6	2	2	2	6	4	6
R46	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R47	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R48	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R49	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R50	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R51	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R52	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R53	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R54	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R55	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R56	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R57	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R58	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1
R59	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R60	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R61	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R62	1	1	1	1	2	1	1	1	1/4	1	1/2	1	1	1/4	2	1/2	1/2	1/2	2	1	2
R63	2	2	2	2	4	2	2	2	1/2	2	1	2	2	1/2	4	1	1	1	4	2	4
R64	1/2	1/2	1/2	1/2	1	1/2	1/2	1/2	1/6	1/2	1/4	1/2	1/2	1/6	1	1/4	1/4	1/4	1	1/2	1

Table A8. Pairwise comparison matrix between risks according to risks' detectability, Part 2.

	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42
R1	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R2	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R3	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R4	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R5	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R6	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R7	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R8	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R9	4	6	6	4	6	6	6	6	6	6	6	4	6	6	6	4	4	4	4	4	4
R10	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R11	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R12	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R13	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R14	4	6	6	4	6	6	6	6	6	6	6	4	6	6	6	4	4	4	4	4	4
R15	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2

Table A8. Cont.

	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42
R16	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R17	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R18	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R19	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R20	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R21	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R22	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R23	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R24	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R25	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R26	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R27	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R28	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R29	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R30	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R31	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R32	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R33	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R34	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R35	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R36	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R37	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R38	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R39	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R40	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R41	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R42	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R43	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R44	4	6	6	4	6	6	6	6	6	6	6	4	6	6	6	4	4	4	4	4	4
R45	4	6	6	4	6	6	6	6	6	6	6	4	6	6	6	4	4	4	4	4	4
R46	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R47	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R48	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R49	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R50	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R51	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R52	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R53	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R54	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R55	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R56	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R57	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R58	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2
R59	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R60	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R61	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R62	1	2	2	1	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1	1
R63	2	4	4	2	4	4	4	4	4	4	4	2	4	4	4	2	2	2	2	2	2
R64	1/2	1	1	1/2	1	1	1	1	1	1	1	1/2	1	1	1	1/2	1/2	1/2	1/2	1/2	1/2

Table A9. Pairwise comparison matrix between risks according to risks' detectability, Part 3.

	R43	R44	R45	R46	R47	R48	R49	R50	R51	R52	R53	R54	R55	R56	R57	R58	R59	R60	R61	R62	R63	R64
R1	1/2	1/4	1/4	1	2	1/2	1/2	1	1/2	1	1	1	1	1/2	1/2	2	1/2	1	1/2	1	1/2	2
R2	1/2	1/4	1/4	1	2	1/2	1/2	1	1/2	1	1	1	1	1/2	1/2	2	1/2	1	1/2	1	1/2	2
R3	1/2	1/4	1/4	1	2	1/2	1/2	1	1/2	1	1	1	1	1/2	1/2	2	1/2	1	1/2	1	1/2	2

Table A9. *Cont.*

	R43	R44	R45	R46	R47	R48	R49	R50	R51	R52	R53	R54	R55	R56	R57	R58	R59	R60	R61	R62	R63	R64
R59	1	1/2	1/2	2	4	1	1	2	1	2	2	2	2	1	1	4	1	2	1	2	1	4
R60	1/2	1/4	1/4	1	2	1/2	1/2	1	1/2	1	1	1	1	1/2	1/2	2	1/2	1	1/2	1	1/2	2
R61	1	1/2	1/2	2	4	1	1	2	1	2	2	2	2	1	1	4	1	2	1	2	1	4
R62	1/2	1/4	1/4	1	2	1/2	1/2	1	1/2	1	1	1	1	1/2	1/2	2	1/2	1	1/2	1	1/2	2
R63	1	1/2	1/2	2	4	1	1	2	1	2	2	2	2	1	1	4	1	2	1	2	1	4
R64	1/4	1/6	1/6	1/2	1	1/4	1/4	1/2	1/4	1/2	1/2	1/2	1/2	1/4	1/4	1	1/4	1/2	1/4	1/2	1/4	1

Table A10. Pairwise comparison matrix between risks according to organization's policy, Part 1.

[illegible]

Table A10. Cont.

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21
R43	4	4	4	4	4	4	4	4	4	2	2	4	4	4	4	4	4	4	4	4	4
R44	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
R45	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
R46	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
R47	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
R48	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
R49	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
R50	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
R51	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
R52	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/4	1/4	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2
R53	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R54	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R55	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R56	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R57	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R58	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R59	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R60	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R61	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R62	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R63	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
R64	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/6	1/6	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4

Table A11. Pairwise comparison matrix between risks according to organization's policy, Part 2.

	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42
R1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R2	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R3	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R4	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R5	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R6	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R7	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R8	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R9	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R10	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	1/2	1/2	1/2	1/2	1/2	1/2
R11	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	1/2	1/2	1/2	1/2	1/2	1/2
R12	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R13	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R14	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R15	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R16	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R17	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R18	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R19	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R20	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R21	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R22	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R23	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R24	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R25	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1/4	1/4	1/4	1/4	1/4	1/4
R26	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1/6	1/6	1/6	1/6	1/6	1/6
R27	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1/6	1/6	1/6	1/6	1/6	1/6
R28	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1/6	1/6	1/6	1/6	1/6	1/6

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Table A12. *Cont.*

	R43	R44	R45	R46	R47	R48	R49	R50	R51	R52	R53	R54	R55	R56	R57	R58	R59	R60	R61	R62	R63	R64
R16	1/4	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4
R17	1/4	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4
R18	1/4	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4
R19	1/4	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4
R20	1/4	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4
R21	1/4	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4
R22	1/4	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4
R23	1/4	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4
R24	1/4	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4
R25	1/4	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4
R26	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R27	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R28	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R29	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R30	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R31	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R32	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R33	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R34	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R35	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R36	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R37	1	6	6	6	6	6	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8
R38	1	6	6	6	6	6	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8
R39	1	6	6	6	6	6	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8
R40	1	6	6	6	6	6	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8
R41	1	6	6	6	6	6	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8
R42	1	6	6	6	6	6	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8
R43	1	6	6	6	6	6	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8
R44	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R45	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R46	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R47	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R48	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R49	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R50	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R51	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R52	1/6	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
R53	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R54	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R55	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R56	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R57	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R58	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R59	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R60	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R61	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R62	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R63	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1
R64	1/8	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1	1	1	1	1	1	1	1	1	1	1	1

Appendix B

Table A13. W_{C1} , W_{C2} , W_{C3} and W_{C4} .

Risk Associated with Vector's Line	Weight Vectors			
	W_{C1}	W_{C2}	W_{C3}	W_{C4}
R1	0.026907974	0.006560894	0.012746344	0.015880281
R2	0.006760961	0.006560894	0.012746344	0.015880281
R3	0.006760961	0.013141076	0.012746344	0.015880281
R4	0.013453987	0.006560894	0.012746344	0.015880281
R5	0.006760961	0.003701471	0.00649918	0.015880281
R6	0.013453987	0.013141076	0.012746344	0.015880281
R7	0.013453987	0.025234707	0.012746344	0.015880281
R8	0.013453987	0.013141076	0.012746344	0.015880281
R9	0.013453987	0.013141076	0.047053256	0.015880281
R10	0.026907974	0.013141076	0.012746344	0.031697096
R11	0.013453987	0.013141076	0.025492687	0.031697096
R12	0.026907974	0.013141076	0.012746344	0.015880281
R13	0.013453987	0.013141076	0.012746344	0.015880281
R14	0.013453987	0.025234707	0.047053256	0.015880281
R15	0.006760961	0.006560894	0.00649918	0.015880281
R16	0.013453987	0.006560894	0.025492687	0.015880281
R17	0.013453987	0.025234707	0.025492687	0.015880281
R18	0.026907974	0.045256153	0.025492687	0.015880281
R19	0.013453987	0.003701471	0.00649918	0.015880281
R20	0.013453987	0.003701471	0.012746344	0.015880281
R21	0.026907974	0.003701471	0.00649918	0.015880281
R22	0.013453987	0.006560894	0.012746344	0.015880281
R23	0.026907974	0.006560894	0.00649918	0.015880281
R24	0.026907974	0.006560894	0.00649918	0.015880281
R25	0.026907974	0.006560894	0.012746344	0.015880281
R26	0.013453987	0.013141076	0.00649918	0.008022616
R27	0.026907974	0.025234707	0.00649918	0.008022616
R28	0.013453987	0.003701471	0.00649918	0.008022616
R29	0.026907974	0.006560894	0.00649918	0.008022616
R30	0.026907974	0.025234707	0.00649918	0.008022616
R31	0.013453987	0.013141076	0.00649918	0.008022616
R32	0.026907974	0.006560894	0.00649918	0.008022616
R33	0.026907974	0.025234707	0.012746344	0.008022616
R34	0.051052342	0.025234707	0.00649918	0.008022616
R35	0.026907974	0.013141076	0.00649918	0.008022616
R36	0.013453987	0.045256153	0.00649918	0.008022616
R37	0.013453987	0.013141076	0.012746344	0.051199864
R38	0.013453987	0.006560894	0.012746344	0.051199864

Table A13. Cont.

Risk Associated with Vector's Line	Weight Vectors			
	W _{C1}	W _{C2}	W _{C3}	W _{C4}
R39	0.013453987	0.006560894	0.012746344	0.051199864
R40	0.013453987	0.006560894	0.012746344	0.051199864
R41	0.013453987	0.013141076	0.012746344	0.051199864
R42	0.006760961	0.025234707	0.012746344	0.051199864
R43	0.013453987	0.025234707	0.025492687	0.051199864
R44	0.013453987	0.025234707	0.047053256	0.008022616
R45	0.013453987	0.025234707	0.047053256	0.008022616
R46	0.006760961	0.003701471	0.012746344	0.008022616
R47	0.013453987	0.013141076	0.00649918	0.008022616
R48	0.013453987	0.006560894	0.025492687	0.008022616
R49	0.013453987	0.025234707	0.025492687	0.008022616
R50	0.013453987	0.006560894	0.012746344	0.008022616
R51	0.006760961	0.006560894	0.025492687	0.008022616
R52	0.006760961	0.013141076	0.012746344	0.008022616
R53	0.013453987	0.006560894	0.012746344	0.004375665
R54	0.013453987	0.013141076	0.012746344	0.004375665
R55	0.013453987	0.013141076	0.012746344	0.004375665
R56	0.013453987	0.025234707	0.025492687	0.004375665
R57	0.013453987	0.013141076	0.025492687	0.004375665
R58	0.013453987	0.045256153	0.00649918	0.004375665
R59	0.013453987	0.013141076	0.025492687	0.004375665
R60	0.006760961	0.025234707	0.012746344	0.004375665
R61	0.006760961	0.025234707	0.025492687	0.004375665
R62	0.006760961	0.025234707	0.012746344	0.004375665
R63	0.006760961	0.025234707	0.025492687	0.004375665
R64	0.006760961	0.045256153	0.00649918	0.004375665

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