

Davis, Jonathan; Vogt, John

**Article**

## Hidden supply chain risk and Incoterms®: Analysis and mitigation strategies

Journal of Risk and Financial Management

**Provided in Cooperation with:**

MDPI – Multidisciplinary Digital Publishing Institute, Basel

*Suggested Citation:* Davis, Jonathan; Vogt, John (2021) : Hidden supply chain risk and Incoterms®: Analysis and mitigation strategies, Journal of Risk and Financial Management, ISSN 1911-8074, MDPI, Basel, Vol. 14, Iss. 12, pp. 1-16, <https://doi.org/10.3390/jrfm14120619>

This Version is available at:

<https://hdl.handle.net/10419/258722>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by/4.0/>



Article

# Hidden Supply Chain Risk and Incoterms<sup>®</sup>: Analysis and Mitigation Strategies

Jonathan Davis and John Vogt \*

GMSC Department, Marilyn Davies College of Business, The University of Houston Downtown,  
Houston, TX 77002, USA; davisg@uhd.edu

\* Correspondence: jvogt@wwbc-inc.com

**Abstract:** Among the many sources of financial and operational risk in supply chains are the Incoterms<sup>®</sup>, which are terms of trade used to decide who does what in a cargo movement, when risk passes from seller to buyer and who pays for which part of the movement. Wrong Incoterms<sup>®</sup> create unexpected costs or risks, at best, and inoperable contracts at worst, with all the challenges implied. This paper analyzes risk in supply chain management (SCM) through the lens of the responsibilities and costs imposed by Incoterms<sup>®</sup>. The authors also conducted a survey of 100 supply chain decision makers on supply chain contracts creation and Incoterms<sup>®</sup> knowledge in the population. Failure mode and effect analysis (FMEA) of Incoterms<sup>®</sup> reveals many scenarios that pose financial, operational, and even legal risk to firms. Results suggest Incoterms<sup>®</sup> rules are poorly understood by supply chain practitioners in general, are often chosen by personnel who are not aware of the implications of their choices, and are therefore frequently chosen incorrectly or non-strategically, thereby increasing cost and risk. This paper discusses the implications of the analysis and survey results on supply chain performance as well as mitigation strategies for practitioners in strategically using Incoterms<sup>®</sup> to remove cost, risk, and delay from supply chain transactions.



**Citation:** Davis, Jonathan, and John Vogt. 2021. Hidden Supply Chain Risk and Incoterms<sup>®</sup>: Analysis and Mitigation Strategies. *Journal of Risk and Financial Management* 14: 619. <https://doi.org/10.3390/jrfm14120619>

Academic Editor: Pius Egbelu

Received: 22 October 2021

Accepted: 14 December 2021

Published: 20 December 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Keywords:** Incoterms<sup>®</sup>; supply chain risk; risk management; logistics; procurement cycle risk; terms of trade

## 1. Introduction

In any trade, the movement, risk and financial aspects are embedded in the trade agreement. Fundamental to these agreements is the question of which organization—buyer or seller—manages what actions, risks and costs in order to move the goods from the seller to the buyer. These predominantly logistics operations are defined by the Incoterms<sup>®</sup> rule chosen by the negotiators. The Incoterms<sup>®</sup> rules in practice take the form of a three-letter shorthand followed by a ‘named place’ and the year of the version of the ruleset that is chosen. For example, “CIP (Loading port terminal address, Country) 2020”. The 11 rules define the obligations, risks and costs to be borne by the seller and the buyer, respectively. If they were perfectly defined, understood, and utilized, there would be no issue; however, they are not simple, nor are they typically chosen by people knowledgeable enough to choose strategically to minimize risk and cost (Davis and Vogt 2021). These circumstances of risk can be exacerbated by not carrying appropriate insurance, issuing detailed instructions to service providers (that do or do not align with the chosen Incoterms<sup>®</sup> rule) and merely hoping that the logistics professionals will muddle through and deliver the goods. This paper will deal with the issues pertaining to the choice of Incoterms<sup>®</sup> rules, which are decided in the negotiation before the goods start to move, but leave the buyer and seller to work in terms of these rules.

Successful supply chain management (SCM) involves meeting operational requirements, or the service standard, at the lowest economic cost and risk. Reducing costs typically means minimizing inventory, negotiating on unit and delivery price, and other

traditional avenues for lowering expenditures. Reducing risk is usually focused on the routine demand-driven stock outs, risk of routine supply chain interruptions (supply failures, delivery or timing issues, and related supply chain quality concerns), emergent supply and demand forecasting failures (weather emergencies driving demand up and supply down, for example), and other such mismatches between supply and demand that are fundamentally external to the organization. Many of these are well understood and can be planned for, but natural disasters such as tsunamis and pandemics cannot be planned for and must be catered for by robust supply chains with cooperation between buyer and seller. For example, the types of disruption in supply chains (Gaudenzi et al. 2020; Lorenc and Kužnar 2021) focus on the operational issues that could be encountered.

The field of “supply chain management” is replete with risk analysis techniques designed to address the above issues around matching supply successfully with demand. Additionally, a search will reveal a great many analyses of emergent risks in SCM. However, a review of the contributions to the literature of SCM risk reveals a significant gap with respect to a wide spectrum view of the risks and consequences of improper use of Incoterms<sup>®</sup>. There is, as of this writing, no work that explores and discusses broadly the operational risks across all rules within the ruleset.

Incoterms<sup>®</sup>, or International Commercial Terms, were first introduced in 1936 and are maintained by the International Chamber of Commerce (ICC 2018; Ramberg 2010). The purpose of Incoterms<sup>®</sup> is to serve as a contractual shorthand for a large amount of language that would otherwise have to be specified anew in the details of each of the millions of sales agreements executed each year. An Incoterms<sup>®</sup> rule consists of three letters indicating the rule to be used, followed by a modifier specifying a point and place of delivery, plus another modifier specifying which version of Incoterms<sup>®</sup> is in use. Each three-letter rule statement stands in for language that declares which party will be responsible for which part of the movement, packaging, materials handling, customs clearance, where delivery occurs, and, crucially, where risk passes from the seller to the buyer. Using this shorthand means both that the contract does not need to detail the standard items covered by the Incoterms<sup>®</sup> rule, and also that supply chain workers need not necessarily refer to the contract to get a good idea of what their responsibilities are (ICC 2000, 2010).

For example, if an item is being sold “EXW”, or “ExWorks”, it should be immediately clear to the buyer’s logistics team that it is up to them to retrieve the item from the seller and arrange and pay for all carriage to the destination. Likewise, if an item is being sold “DAP”, or “Deliver at Place”, it will be immediately clear to the seller’s logistics team that it is up to them to arrange and pay for export and delivery all the way to the buyer’s named international destination. This shorthand is a great convenience to both parties and, when used correctly, elevates the important details of the transaction out of the bowels of the contract and into the attentions of all involved.

The Incoterms<sup>®</sup> are regarded internationally as the de facto means to define the domestic and international movement requirements from the buyer and seller (ICC 2020) and have continually been updated as industry practice has changed. Hence, new terms have been added over the years that add features and flexibility to accommodate more modern cargo transport methods, such as air transport and containers. The latest version of Incoterms<sup>®</sup> (2020) includes 11 rules as summarized in Table 1.

**Table 1.** Incoterms<sup>®</sup> Rules Description, Modes and Handoff.

Rule	Description	Location of Handoff	Mode
EXW	Ex Works	Seller’s premises	All
FCA	Free Carrier	Domestic to the seller	All
CPT	Carriage Paid To	A point between the buyer and seller	All
CIP	Carriage and Insurance Paid	A point between the buyer and seller	All
DAP	Delivered at a Place	Domestic to the buyer	All

**Table 1.** *Cont.*

<b>Rule</b>	<b>Description</b>	<b>Location of Handoff</b>	<b>Mode</b>
DPU	Delivered at a Place, Unloaded	Domestic to the buyer	All
DDP	Delivered Duty Paid	Domestic to the buyer	All
FAS	Free Alongside Ship	Quayside for export	Water
FOB	Free on Board	Loaded on board ship for export	Water
CFR	Cost and Freight	Between the buyer and seller	Water
CIF	Cost, Insurance and Freight	Between the buyer and seller	Water

For each of these rules, there are 10 articles in the official Incoterms<sup>®</sup> documentation that cover the various categories of expectations being set:

1. General obligations;
2. Delivery and taking delivery;
3. Transfer of risks;
4. Carriage;
5. Insurance;
6. Delivery and transport documents;
7. Export/import clearance;
8. Checking, packaging, and markings;
9. Allocation of costs;
10. Notices and communications.

Within these, there are several areas of explicit risk described for which we must account. While they cover many practical aspects, they leave many of the details to common practice or to be agreed between the buyer and seller, such as the proof of delivery document. However, there are also undocumented sources of financial and operational risk that are fundamentally internal to each organization, and that are not significantly represented in the supply chain or financial risk literature. In the execution of any supply chain cycle (procurement, logistics, and fulfillment), the map describing how the cycle will unfold is determined by the sales contract. In this contract, many things are agreed upon which overtly bear on cost and risk, such as the aforementioned movement and intermediate storage of the logistics of the goods. The contract also specifies the Incoterms<sup>®</sup> rule, which determines a great deal about whether the trade will unfold to the best and safest advantage of both parties. Nestled within these Incoterms<sup>®</sup> rules are the obligations, including the role and responsibilities of the buyer and seller, the risks and the costs borne by the respective parties under the rule. However, the choice of the rule comes with multiple questions, supported by the fact that in many companies the choice is not made by parties with detailed Incoterms<sup>®</sup> rules knowledge. The determinations that need to be made for the choice of the appropriate rule are:

- The most capable party will perform the logistics (or the least capable);
- Trade law compliance is built into the process (or whether the seller faces exposure);
- Export and import clearance is made easy (or difficult, or even possible);
- Expectations will be (or even can be) met regarding delivery to the customer;
- The trade can legally be completed as drawn up (or whether the contract will have to be torn up and re-drawn);
- The risk profile of the transaction is appropriate to the price of the transaction (or whether the price fails to adequately account for risk of one party or another);
- The trade will be underwritten and funded by the banks involved, including if Letters of Credit are utilized (or refused);
- Delivery occurs at a predictable and specific time and place (or whether delivery terms are vague and subject to the whims of the seller);

- The cargo movement details are arranged by the party with the risk (or by the party with zero risk).

Incoterms<sup>®</sup> play a critical and largely direct role in determining all these realities and more for each supply chain cycle executed and yet receive very little in the way of attention from practitioners and researchers. To the extent that practitioners effectively select and apply Incoterms<sup>®</sup> rules to match the needs of their supply chain circumstance, Incoterms<sup>®</sup> will support the reductions in cost and risk that are crucial to today's competitive SCM. To the extent practitioners do not, the opposite is true (Hansen et al. 2014; Davis and Vogt 2021). This initial study uses an exploratory survey of Incoterms<sup>®</sup> practitioners to determine their attitudes, capabilities, and performance with respect to risk mitigation in the supply chain. An analysis of these results will describe the gap between application and risk mitigation opportunity and make recommendations about how cost and risk may be optimized via enhanced application of Incoterms<sup>®</sup> rules. Furthermore, this paper explores an FMEA model that proposes an approximate risk profile for Incoterms<sup>®</sup>-related failure modes and effects.

While the literature contains a great deal on general monetary risk and financial risk in logistics and trade (see Alexandridis et al. (2018) for a comprehensive review and Bergami (2013)), there is very little peer-reviewed research on the uses and related operational risks of trade terms (Vogt and Davis 2020). There are known problems inherent in the modern formulations of the Incoterms<sup>®</sup> ruleset, as described by Davis and Vogt (2021), albeit without itemizing them all or recommending specific mitigation strategies. This paper made the case that the challenges and risks associated with the confusing and overlapping formulation of modern Incoterms<sup>®</sup> are such that they required a stark re-imagining, rather than a campaign to mitigate risks and improve usage across many thousands of practitioners. One counterpoint to that notion would be the long interval between Incoterms<sup>®</sup> revisions (typically ten years) as well as the moderate-to-low probability of a complete revision, both of which suggest near-term mitigation and promotion of strategic thinking may be appropriate.

Acknowledging the role of Incoterms<sup>®</sup> in determining outcomes from environmental risks, Stojanović et al. (2021) argued that the decision makers (implied by the Incoterms<sup>®</sup> rules chosen) either facilitate or impede a culture of risk awareness, depending on their decisions for the choice of rule, and responsibility regarding environmental issues, depending on the rule used, the circumstances, and the portion of the trade cycle under consideration. It is not hard to imagine that the same dynamic would apply to operational risks and costs, generally. After all, in the absence of proper risk mitigation, operational risks that materialize must be overcome either by collaborative goodwill or by the courts.

Operational risks are a known aspect of at least some Incoterms<sup>®</sup> rules. Bergami (2016), for example, explores the financial risks associated with improper use of delivery terms, and the rule "DDP" in particular. So extreme is the risk, argues Bergami, that the DDP rule may well be best never used at all. This example of the legal exposure inherent in DDP is a dramatic indicator of the kinds of lesser hidden risks that may lurk in other rules, which will be explored herein.

In all cases, there is the potential for risks where there is lack of precision, misunderstanding, incorrect use, etc. The increased risk increases the likelihood of either the buyer or seller duplicating effort, or one or the other lacking an entity to carry out a step in the process of moving the goods or for both of the entities trying to perform a step and confusion resulting. Any of these result in delays or other issues between buyer and seller that increase costs, and usually are only resolved by the goodwill of the buyer and seller trying to satisfy the customer.

This paper is unique in that it reflects the risks and the particular issues with each of the Incoterms<sup>®</sup> rules from practice. This is the first time to the authors' knowledge that any such attempt has been made. The results will help both operational parties, as well as future research as the researchers try to highlight the shortcomings of the trade negotiation coupled with the choice of the Incoterms<sup>®</sup> rule chosen.

### *Failure Mode and Effect Analysis (FMEA)*

Among the most common tools of operational risk managers is failure mode and effect analysis (FMEA). FMEA is an analysis tool that helps risk management identify potential risks and prioritize them for mitigation on the basis of each risk's likelihood and impact (Stamatis 2003). The tool was first used in the 1960s for operational reliability and has since been integrated into more modern process improvement paradigms such as Six Sigma. A key aspect of this process improvement utility is its ability to focus experiential knowledge on anticipating and mitigating future problems in that same space of experience.

There are many different variants of the FMEA, and these variants have been successfully proposed and employed across a great multitude of risk circumstances, such as in medicine and health care (Sawant et al. 2010; Shebl et al. 2009), engineering (Lo et al. 2019; Ben-Daya 2009), and operational decision sciences (Liu et al. 2019a, 2019b).

The flexibility of FMEA to apply to many different regimes to proactively identify, prioritize, and mitigate risks makes it a viable tool for use in this study as well. While the FMEA traditionally utilizes three factors of failure modes (what could go wrong), failure causes (what would be the cause) and failure effects (what are the consequences of the failure). Further analysis can include process control effectiveness and detection ratings. For this analysis, the authors have limited the use of the FMEA analysis to the modes, causes and effects as subsequent work would be far too case specific, leading to too many permutations of detectability that would be unwieldy and "ungeneralizable". For each Incoterms<sup>®</sup> rule, all the potential failure modes were identified. For each of these failure modes, the consequence was defined; and for each of these, a severity and likelihood category (1 lowest to 3 highest) was assigned. This risk level in the FMEA parlance gives the ranking for the issues of concern with the use of Incoterms<sup>®</sup> rules in industry and allows for the conclusions reached as to where Incoterms<sup>®</sup> rules can cause issues and cause trades to encounter problems.

## **2. Materials and Methods**

This study brings together three methods of analysis and then strategies that flow from these analyses. First, potential risks (failure modes) related to Incoterms<sup>®</sup> selection and application are enumerated. Next, an exploratory survey of industry professionals is used to gauge practitioner knowledge and performance relative to Incoterms<sup>®</sup> risks and is used to quantify the likelihood of failure modes. Third, the Incoterms<sup>®</sup> risks are subjected to a rough failure mode and effect analysis model designed to propose a best estimate of the various risk ratings. This model of risk proposes a way of understanding and prioritizing these risks as objectively as possible, given the inherently "fuzzy" nature of the dynamics of widespread Incoterms<sup>®</sup> selection and application. To the extent possible, likelihoods are anchored to survey data. Finally, an Incoterms<sup>®</sup>-based risk mitigation strategy is drawn from the FMEA results.

The survey was created, tested, and refined to gain insight into the awareness, effectiveness of usage, and general knowledge of Incoterms<sup>®</sup> rules by industry professionals. The authors developed questions and the resulting survey was validated by feedback from industry experts. After approvals by IRB (required institutionally for any survey study), the survey was piloted to reveal areas for improvements in question clarity, particularly considering the international nature of the topic, prior to final survey distribution. The survey contained questions designed to gauge the depth, breadth, and accuracy of practitioners' working knowledge of the Incoterms<sup>®</sup> rules.

The final survey was distributed widely through forums frequented by supply chain industry professionals, and via email distribution to known supply chain professionals. The survey was also made known at meetings of industry professional groups, including the Institute of Supply management (ISM) and the Council for SCM Professionals (CSCMP), two of the major SCM organizations in the USA and a number of other countries. The survey recorded 100 responses, 84 of which were substantially complete and usable. While many of these were from overseas, the majority were based in or traded with the USA as

some questions involved the confusing commercial term unique to the USA called FOB Delivered. This term is not part of the Incoterms<sup>®</sup> but is in the Commercial Code for the USA.

### 3. Results

A summary of the study results follows.

Over half of respondents reported limited experience to no experience with Incoterms<sup>®</sup>, yet were involved in selection or are the primary decision makers for the choice of Incoterms<sup>®</sup> rule. The skill and detailed knowledge level to ensure the most appropriate Incoterm<sup>®</sup> were reported as not present in most companies. The responsibility for selecting the Incoterms<sup>®</sup> rule resided in different functional departments across the respondents. The data indicated that procurement and logistics functions tend to dominate the selection of rules, but that sales and even technology services and warehousing are sometimes the dominant selectors.

Over half the respondents reported using outdated versions of Incoterms<sup>®</sup> rules rather than the current 2020 version. This places a greater onus on the personnel to understand the nuances of different versions, and to ensure their trade partners are aware of the differences between the versions, thereby adding unnecessary complexity and increased risk. This coincides with the issue that 51 percent of respondents' companies standardized on only one rule for all contracts, regardless of trade direction or details, and a further 16 percent standardized on only two rules—one for sales and one for procurement—regardless of other considerations. This one rule for all contracts ignores the abilities of the companies involved in the trade and whether they can carry out the movement segments more efficiently and effectively than the other party in the trade. This is not generally true as companies' efficiency and contracts for movement are partially dependent on the frequency and volume moved in a logistics lane.

The choice of Incoterms<sup>®</sup> rule under these circumstances must be suspect and this is borne out by other data points. Nearly one-third of the companies responding used an inappropriate rule for ocean containers, introducing risk and complexity to each movement. The water-only FOB rule was reportedly used by 10 percent of respondents for air moves (explicitly precluded by the rules) and by 22 percent for rail/truck movements. Some 28 percent of respondents report using "D" rules for domestic moves even though all "D" rules are meant for delivery at the country of import.

In the USA, there was the Uniform Commercial Code (UCC), which was created in the mid-1950s and has a few terms which look like Incoterms<sup>®</sup>. The code was adopted by all states, with some variations, besides Louisiana with its Napoleonic legal background. UCC rules hold only for domestic USA moves and have no standing in international moves. Yet, nearly two-thirds of U.S. respondents use one or other of these obsolete and inapplicable UCC rules, further raising the risk profile of their trades.

There is a perception among respondents that more than 40 percent of the people involved in the use of or choice of Incoterms<sup>®</sup> recognize and want formal training. This is not surprising as more than 40 percent of the respondents who are implementing the logistics for the trades under these Incoterms<sup>®</sup> reported the belief that their company regularly chooses an incorrect Incoterms<sup>®</sup> rule.

This industry feedback, coupled with detailed understanding and knowledge of the Incoterms<sup>®</sup> and feedback from discussions, allows the authors to define potential failure modes for Incoterms<sup>®</sup>. While the specifics of the survey results informed the selection of likelihood ratings, these results are not the focus of this paper. A sample of these survey results is available in the Appendix A for review.

The failure modes for every sensible potential misunderstanding or misuse of the Incoterms<sup>®</sup> rules were generated based on the papers which preceded this paper (Vogt and Davis 2020; Davis and Vogt 2021) and the survey as mentioned earlier. These two papers explored Incoterms<sup>®</sup> and their history of changes, as well as looking into the issues of understanding and the latter paper postulates a radical new method of presenting these

rules with a much more limited number of rules and an increased number of modifiers in addition to the named place. These works enabled the authors to also assign a probability to the failure mode of the that event occurring. While these weightings are the authors', they are supported by the results of the survey and the experience of the authors in preparing the research articles and general articles on this topic.

### 3.1. Failure Modes, Likelihoods, and Impacts

A list of possible failure modes (risks) cannot be exhaustive, as the potential for unforeseen failures is limited only by imagination. There are, however, likely failure modes that flow logically from the expression of Incoterms<sup>®</sup> rules, the responsibilities conferred, and the operational or conceptual gaps that either exist or could result from the imperfect understanding and application evident in survey responses. A list of general risks could be proposed as follows.

- Liability from export compliance failure;
- Damage by the party not responsible for the goods;
- Damage responsibility impossible to accurately attribute due to risk transfer point;
- Difficulty resolving damage disputes due to rule inapplicability;
- Delay from uncertainty about responsibilities due to rule inapplicability;
- Loss due to an unacknowledged transfer of risk and responsibility;
- Confusion about materials handling responsibilities, and therefore risk;
- Delays, loss, or liability from poor route or carrier selection by the party with no risk;
- Unanticipated liability due to underinsurance in rules with insurance requirements;
- Inability to execute contract as written due to incompatibility with import laws;
- Costs due to failure to strategically choose a rule that leverages capabilities.

This list describes general sources of risk and outcomes, but a look at the specifics underneath reveals that many quite different scenarios may give rise to these failure modes. Each of these can be taken in turn to better describe the failure mode and its features.

#### 3.1.1. Liability from Export Compliance Failure

All Incoterms<sup>®</sup> rules (except one) require sellers to supply documentation for export and thereby set the expectation of goods sold for export. FCA, for example, requires that the documentation about the origin of goods and any relevant documents for export be made available to the buyer. This not only serves to ease the transfer of information, but also sets the expectation in the seller that the buyer must be vetted along with the ultimate destination of the goods against compliance with export law. EXW, by contrast, is the lone rule that sets the expectation of a domestic-only sale and end destination. Its intent as a purely domestic term of trade means that unscrupulous buyers intending to quietly export goods to forbidden destinations will use it to deflect attention, leaving the seller to face the investigation if a Customs Authority finds untoward submissions.

Assessing the frequency (and therefore likelihood) of any of these risks will be an imperfect exercise. However, survey responses indicate that 24% of respondents use EXW for moving ocean containers, 16% used EXW for ocean breakbulk, and 20% used EXW for ocean bulk movements. In each case, EXW was either the most popular choice or the second-most popular choice of rule (by a slim margin). That EXW is wholly inappropriate for heavy cargos and international moves serves to undergird the larger point about risk and Incoterms<sup>®</sup>, but specifically here the risk of unvetted export of controlled goods or goods to restricted destinations seems quite significant. On a scale of "low", "medium", and "high", the likelihood would seem to be at least high. Additionally, should the failure mode occur and be noticed by export control authorities, the consequences of non-compliance with export law would be very high indeed.

#### 3.1.2. Damage by the Party Not Responsible for the Goods

This failure mode can flow from several misapplications of Incoterms<sup>®</sup> rules. The first (and perhaps most common) example is using EXW for heavy cargo. Since EXW entails



handling the goods on the seller's premises, but risk transfers prior to handling the goods, either the buyer operates heavy equipment on the seller's premises (unlikely) or the seller loads goods for which the seller has no risk or responsibility. This means any damage caused by the seller loading the goods is now a dispute. The buyer did not cause the damage, but has liability (perhaps unknowingly). The likelihood of this occurring, given the widespread misuse of EXW for heavy cargo, is reasonably high, and the cost is perhaps "medium" as well. Only the prevailing courtesy of many sellers to accept responsibility anyway prevents this from being assessed as "high" cost. In cases where they do not, the cost includes the damage to the goods, of course, but also the ensuing dispute and the damage to the relationship.

Additionally, the "C" rules are sources of this type of failure, because these rules explicitly call for the seller to handle the goods and arrange for their delivery largely after having been absolved of any responsibility. CPT and CFT, in particular, score highly in this regard because these rules neglect to require insurance to protect the buyer, and damage to cargo in general is not an uncommon occurrence.

### 3.1.3. Damage Responsibility Impossible to Accurately Attribute Due to Risk Transfer Point

In most circumstances, a risk transfer point can be safely established anywhere. However, in cases where the cargo is sealed for the voyage, such as with containerized cargo, the risk transfer point needs to be established where the cargo can be verified intact prior to the risk passing. For this reason, the (mis)use of FOB for containerized cargo creates a scenario where any damage that occurs after the cargo is sealed—but before risk is transferred—cannot be appropriately assigned. With FOB, risk passes only once the container is resting on board the vessel. However, prior to this, the seller sealed the container and then handled the container into place alongside the vessel and then lifted the container onto its resting place as (likely) part of a container stack. If any damage occurred during this process, it will be impossible to differentiate it later from damage that occurred during the voyage or during the unloading process.

As mismatched as FOB is for container use, one might expect its use to be rare. However, survey results show that 17% of respondents report using FOB for ocean container movements, third highest behind EXW and FCA. As such, the likelihood of this scenario is high, even if the likelihood of damage from the failure mode itself is only low to medium. The consequences are either a dispute or damage that is wholly owned by the buyer, regardless of the true source of the damage, and therefore greater risk and liability due to using an inappropriate rule.

### 3.1.4. Difficulty Resolving Damage Disputes Due to Rule Inapplicability

There are several circumstances where using an inapplicable rule creates a strange conflict of trade assumptions and renders dispute resolution more difficult. One scenario is the aforementioned FOB, this time used for any non-water movement. This misuse is very common due to FOB's superficial similarity to the antiquated UCC rule, which is unfortunately also called "FOB". The modern Incoterms® rule "FOB" is a water-only rule that specifies a transfer of risk once placed on board a water vessel. If a water vessel is never used (due to misapplication of FOB for ground transport), where then does risk transfer? Additionally, when damage occurs, whose responsibility does it become? Unfortunately, again, 22% survey respondents report (mis)using FOB for domestic ground transport, tying it with FCA as the most used ground transport rule. A further 10% of respondents reported using FOB for air cargo, which was the third most cited rule for this mode. Therefore, the likelihood of failure here is high, and the consequences are likely to be high as well.

A similar problem exists for other water-only rules, such as FAS, used inappropriately in non-water applications. If risk transfers only once alongside a ship, where does risk transfer if a ship is never involved?

CFR and CIF are also water-only rules, and the risk transfer point is on board the vessel, much as with FOB, with much the same risk features, except these are much less commonly misused for non-water movements.

Another common scenario of rule inapplicability is using DAP, DPU, or DDP for domestic movements when these three apply explicitly to international movements. However, as the risk transfer point is explicitly stated in the usage of the rule, rather than embedded in the rule's definition, these rules are less susceptible to this failure mode.

### 3.1.5. Delay from Uncertainty about Responsibilities Due to Rule Inapplicability

One source of this delay stems from confusion of FOB with the older and outdated UCC (from the mid-1950s) version of FOB. The UCC version specifies very different responsibilities than does the modern Incoterms<sup>®</sup> rule, and (primarily US-based) buyers or sellers who use FOB internationally thinking it must work as specified in the UCC, will be in for surprises. The UCC version has multiple tiers of risk. The inherent problem is the UCC is a code, and to become a law it had to be adopted by each state. The adoption process was not uniform, and so different understandings and nuances exist. Indeed, the case of Louisiana with its tie to the Napoleonic code has never fully ratified this code. The UCC version addresses some aspects of risk but does not approach the detail of international movement and correct insurance for these movements. To compound all this confusion, the UCC has two terms, FOB Loaded and FOB Delivered, and each has different requirements. These two terms include the use of a "Free on Board" description which is inherently associated with ships today, but in this code holds for trucks or any mode. These terms do not supersede the Incoterms<sup>®</sup> rules and are not preferred since Incoterms<sup>®</sup> rules hold for both domestic and international movements. The use of the old UCC terms is risky both for the confusion they can sow within the U.S. (where they still legally could apply) as well as the much greater problems caused by using them for movement internationally (where they have no legal weight or application at all). In each case, the risk is the same: namely that the shipper and/or consignee be left with a mismatch between expectations and outcomes with the chosen rule providing inadequate cover under the law.

### 3.1.6. Loss Due to an Unacknowledged Transfer of Risk and Responsibility

There are multiple scenarios where an Incoterms<sup>®</sup> rule specifies risk transfer at a moment when the new owner of that risk may not be present or may not be sufficiently knowledgeable to be aware of the change. EXW, as an example, specifies that risk transfers when the goods are "placed at the buyer's disposal", or made available to the buyer, at the seller's warehouse. The rule agrees that a time or range of times could constrain this delivery, but any lack of specificity creates risk. The survey returned no company that utilized these time constraints. However, for example, a delivery on Tuesday, 7 January 2022 seems specific enough, but placing the goods at the buyer's disposal, outside, on the seller's dock at 12:03 a.m. of that date leaves the cargo at the risk of the buyer and at the mercy of any number of ruinous forces. Quite apart from the usual materials-handling risks associated with EXW, this risk begins the moment the seller considers the goods to have been delivered, and involves any errant forklift, any inclement weather, and any curious thief.

Another risk scenario involves using FAS for any regular liner cargo. In this scenario, goods are delivered to the quayside or terminal to await the vessel. For however long it takes for the vessel to arrive, any quayside mishaps are the responsibility of the seller, since the cargo will not have arrived alongside the ship. A similar problem applies to FOB, and for much the same reasons. Until the ship actually arrives and the material is handled into position, the risks belong to the seller, whether acknowledged or not.

Finally, the "C" rules without insurance (CFR, CPT) are a great source of confusion around risk, since all "C" rules alone transfer risk much earlier than they transfer responsibility. Sellers, in general, are happy to use a "C" rule, provided they have the logistics expertise, because the logistics portion becomes an additional profit generator without

adding risk for them. Buyers, on the other hand, may not be sufficiently aware of their ownership of the risk throughout the voyage whose route and choice of service providers is done by the seller, and may not, therefore, take adequate care to mitigate the risk. Given the survey results around confusion of Incoterms<sup>®</sup>, the likelihood of this risk appears to be high, even if the impact is just increased risk.

### 3.1.7. Confusion about Materials Handling Responsibilities, and Therefore Risk

The issue with materials handling under EXW is well documented here, but that issue is generally not a problem borne of confusion but necessity. With other rules, simple lack of familiarity with the rule can create issues where, for example, sales promises terms that logistics cannot or does not honor. With DPU, for example, the rule calls for the seller to unload. Failure to understand and account for this requirement leads to cargo sitting on a truck nowhere near a loading dock and no equipment in sight. This may sound like merely a short term to find or free a forklift, but for many cargoes and particularly those of large size or heavy weight this can be a major issue and delay, with the attendant costs.

More commonly, though, FCA specifies multiple material handling scenarios under one rule, governed by the point of transfer. If the goods are transferred on the seller's premises, then the seller loads. If the goods are transferred at some other point, then the buyer unloads. That is confusing enough, but if there are multiple legs of transport before the point of transfer, the responsibility of material handling may be further obscured. For example, if the goods are transported from the seller's facility to another facility owned by the seller. Who loads in this scenario? Who bears the risk and at what point?

DDP, as an extreme case, is a rule that establishes complete control of the movement by the seller all the way up to the delivery destination. The rule can be understood mainly as providing maximum transactional relief to a buyer that has zero expertise or capability in logistics. However, hidden underneath the name of the rule is the fact that the rule requires the buyer to unload the goods upon arrival. The likelihood of an inexperienced buyer to understand Incoterms<sup>®</sup> sufficiently to be able to prepare for this need is hard to estimate, but the risk of failure would seem to be high.

### 3.1.8. Delays, Loss, or Liability from Poor Route or Carrier Selection by the Party with No Risk

The "C" rules specify that the seller will bear no risk during the main voyage but will nevertheless be responsible for arranging and paying for transport to the named point and place in the destination country of import. For sellers, this is, again, a great opportunity for profit without risk. For buyers, this can be a risk without recourse. Less savvy buyers are at the mercy of the sellers to hopefully select routes that a) do not venture into forbidden waters with goods that are the responsibility of the buyer, or b) take the goods on a riskier or disadvantageous—time or routing—journey. Similarly, buyers must rely on the seller to select carriers that employ well-qualified personnel, move cargo using good equipment, and generally prioritize the safety and on-time delivery of cargo. Needless to say, there could certainly be a financial disincentive for sellers to do so without proper awareness and controls by the buyer. Paradoxically, though, "C" rules were established for situations where less-than-savvy buyers with less transactional power than sellers can nevertheless get a trade accomplished. For these reasons, "C" rules represent a substantial risk to buyers.

### 3.1.9. Unanticipated Liability Due to Underinsurance in Rules with Insurance Requirements

The "C" rules, again, come under scrutiny for their complexity and inscrutability to many buyers. In this scenario, however, we examine the insurance clause of the CIF. Whereas CIP calls for "A" level insurance (most comprehensive movement insurance), CIF call only for "C" insurance, which omits coverage for a variety of harms. In addition, for both rules the insurance is only in place for the cargo through "delivery", which just means the point and place named. To exacerbate this, the unloading at this point devolves to the buyer, but is not covered by this insurance. This point and place may not be the point

where the buyer personally takes possession, and confusion about this may expose the buyer to risk.

### 3.1.10. Inability to Execute Contract as Written Due to Incompatibility with Import Laws

Import law varies from country to country, and some countries have more stringent laws than other with regard to who, precisely, is permitted to clear incoming cargo through customs. The US, for example, requires that only parties domestic to the USA are legally capable of clearing import customs in this way, and other countries have this restriction as well. This becomes problematic under DDP when a contract is created that requires a foreign entity to clear import customs to fulfill the contract terms. This problem can be highlighted further by the case of the Australian Customs Authority which held the buyer responsible for the fraudulent customs submissions of the seller, much as it was done under DDP rule (Bergami 2016). It is worth restating that DDP is a rule that seems to serve inexperienced buyers, mainly, who are disproportionately likely to be unaware of the law surrounding imports. Therefore, under DDP, it is disconcertingly easy to create a high-service trade scenario that is impossible to execute, which leads to delays and costs.

### 3.1.11. Costs Due to Failure to Strategically Choose a Rule That Leverages Capabilities

This might appear to be an uncommon problem, as very few references in research papers reflect this. However, in practical terms, this is an issue that is far more common than expected, particularly with inexperienced Incoterm<sup>®</sup> users. Let us illustrate this with two examples from the authors' backgrounds. A US buyer found a new machine manufacturing company in India. The buyer set up the contract with DDP, and a requirement to deliver on demand or call-off by the buyer from stock in the USA. The manufacturing company had no logistics understanding or presence in the USA as it was their first international contract. To fulfill this contract, they had to set up a registered company in the USA to perform customs clearances, create a stock holding location by renting a warehouse and employ third-party transporters. The costs for this were significantly above what they expected, and for the first year the service was severely compromised. All this could have been overcome by the buyer choosing instead a "C" rule and storing the goods for the Indian company in one of their own warehouses, which they already had in place.

It becomes apparent that the drive from a dominant buyer or seller can and does cause inappropriate choices of Incoterms<sup>®</sup>, simply through lack of care or inertia. While the consequences of this are less profound when both parties have strong logistics and Incoterms<sup>®</sup> knowledge, the choice must not be made only on the knowledge, but on each party's capabilities for the lane. For example, a bulk product supplier agreed to send containers of goods to Mozambique in our experience under a C term. However, the supplier had no skill or knowledge of shipping to the east coast of Africa, having never shipped to the region before. The choice of vessel was a tramp steamer, and it bypassed the port in Mozambique for nearly 2 months until it suited the vessel to call. The buying company ran out of product and had to cease operations for weeks.

In the course of the investigations into trade, the authors came across multiple occasions where companies duplicated services. The most egregious was where breakbulk boxes were unloaded from a vessel to a quayside terminal. Three parties checked the boxes—the ship, the seller and the buyer.

There are many other examples possible. However, the issue is that the companies either ignore the strategic implications of Incoterms<sup>®</sup> or use Incoterms<sup>®</sup> that expose them to risk and costs. The choice of using the Incoterms<sup>®</sup> to make the best use of the capabilities of the whole delivery chain makes the potential risk much lower and the costs lower and, more importantly, the ability to recover or overcome risks significantly higher. The imbalances of trade power coupled with imperfect knowledge of logistics generally and Incoterms<sup>®</sup> specifically virtually guarantees that minor and major mistakes in trade occur constantly, where a preference (or habit) of Incoterm<sup>®</sup> rule by a powerful party imposes small, medium or large additional costs on the transaction by forcing the less capable party

to perform too much of the logistics work. Quantifying this failure mode is, at present, impossible, but the frequency is likely to be very high, and the impacts are likely to range from low in many cases to high in some. However, it is the likely pervasiveness of this problem that suggests it is a silent vampire, quietly sucking value from most transactions.

### 3.2. Failure Mode and Effect Analysis

The FMEA presents a large amount of analysis into one table. Every sensible potential failure category of the Incoterms<sup>®</sup> rules is listed, commented on, with the failure cause, mode listed. The authors have added a root cause section, which is an addition to the traditional FMEA. These then give a comprehensive overview of the potential failures and hence risks inherent in the imperfect use of Incoterms<sup>®</sup>. This table is completed with the severity rating which is the author's assessment of the impact on a trade, and the occurrence rating which is essentially the frequency or potential to occur rating.

FMEA takes several typical forms, and many of those forms use a third category of analysis that attempts to account for the "detectability" of the risk, for example. Applied to relatively narrow circumstances, such as one particular logistics movement, such a detectability analysis is a straightforward improvement to the analysis and decision about whether to invest resources in avoiding or mitigating that particular failure mode. However, in this usage of FMEA, the goal is not to enumerate particular scenarios but instead multiple categories containing thousands of potential scenarios, each of which could have circumstances that entailed different assessments of detectability but very similar assessments of both likelihood and severity. For this reason, the FMEA herein (perhaps better understood as a "meta" FMEA) eschews the third category. Moreover, as this FMEA is meant to gain a sense of overall risk landscape, it does not use ten distinct numerical ratings for each assessment, but rather a more categorical three levels of assessment ("1", "2", or "3", with "3" being the "most likely" or "most severe". This approach allows the FMEA to triangulate, in a more general sense, the risks associated with these categories of Incoterms<sup>®</sup> failure scenarios while avoiding the inappropriate distinctions that would flow from a more granular analysis.

The result is a FMEA "risk priority number", which is the product of these two ratings and is shown in Table 2.

**Table 2.** Proposed Failure Mode and Effect Analysis.

Failure Mode and Source	Likelihood	Severity	Risk Priority Number
<i>Liability from export compliance failure</i>			
EXW	3	3	9
<i>Damage by the party not responsible for the goods</i>			
EXW	3	2	6
CPT and CFR	3	3	9
<i>Damage responsibility impossible to accurately attribute due to risk transfer point</i>			
FOB	3	2	6
<i>Difficulty resolving damage disputes due to rule inapplicability</i>			
FOB	3	3	9
FAS	1	3	3
CFR and CIF	1	3	3
DAP, DPU, DDP	0	3	0
<i>Delay from uncertainty about responsibilities due to rule inapplicability</i>			
FOB	3	1	3

Table 2. Cont.

Failure Mode and Source	Likelihood	Severity	Risk Priority Number
<i>Loss due to an unacknowledged transfer of risk and responsibility</i>			
EXW	2	2	4
FOB	2	2	4
FAS	1	2	2
CFR and CPT	3	2	6
<i>Confusion about materials handling responsibilities, and therefore risk</i>			
DPU	1	2	2
DDP	3	2	6
FCA	2	2	4
<i>Delays, loss, or liability from poor route or carrier selection by party with no risk</i>			
CFR, CPT	2	2 to 3	4 to 6
CIP, CIF	2	1 to 3	2 to 6
<i>Unanticipated liability due to underinsurance</i>			
CIP	1	3	3
CIF	2	3	6
<i>Inability to execute contract as written due to incompatibility with import laws</i>			
DDP	2	3	6
<i>Costs due to failure to strategically choose a rule that leverages highest capabilities</i>			
All Sources	3	1 to 3	3 to 9

#### 4. Discussion

The primary problems and risk for Incoterms<sup>®</sup> rules are given by the scores above. If we consider those scores of 6 or above as the larger and more common issues, then we have 5 major problems in Incoterms<sup>®</sup> rules risks. These are listed in order of the total score from the above table in descending order:

- Damage by the party not responsible for the goods (EXW 6; CPT, CFR 9);
- Costs due to failure to strategically choose a rule that leverages highest capabilities (6 to 9);
- Damage responsibility impossible to accurately attribute due to risk transfer point (FOB 6);
- Liability from export compliance failure (EXW 9);
- Difficulty resolving damage disputes due to rule inapplicability (FOB 9);
- Loss due to an unacknowledged transfer of risk and responsibility (CFR, CPT 6);
- Confusion about materials handling responsibilities, and therefore risk (DDP 6);
- Unanticipated liability due to underinsurance (CIF 6);
- Inability to execute contract as written due to incompatibility with import laws (DDP 6).

Multiple rules and multiple scenarios give rise to these larger risks, but summing the problem scenario risk scores for each rules gives an overall score:

- EXW (15),
- CPT and CFR (15),
- FOB (15),
- DDP (12), and
- CIF (6).

Interestingly, the rules that suggest the highest risks are not ones that have appeared in recent editions (i.e., DPU), but rather are ones that have been in use for many decades across many Incoterms<sup>®</sup> versions (i.e., EXW and FOB).

Beyond these, the failure to choose and apply a rule strategically is the risk scenario that cuts across all rules and could therefore be considered a “meta risk” that is at play regardless of the details of a trade. Any misunderstandings of the details and nuances of rule application or real-world capabilities of the trade partners results in higher risk. Therefore, mitigation of this risk is about depth of knowledge and situational awareness, and the application thereof. It is practice in many organizations to have a standard Incoterms<sup>®</sup> rule for all sales contracts and the same or a second standard rule for all procurement contracts. Such policy is unlikely to optimize the outcomes for the organization, though as a heuristic it may serve to prevent egregious errors in contract terms. Such heuristics, however, virtually guarantee that the risk of establishing inferior (and therefore riskier and more expensive) trades becomes reality at some point with some trading partner whose capabilities violate the assumptions behind the choice of standard rules.

The choice should be made to ensure that the logistics processes for the total movement should be chosen based on the capabilities of the buyer’s and seller’s organizations. This reduces risks and costs as the best of the two organizations utilize their capabilities and contracts.

These risks highlight the issues practitioners have with Incoterms<sup>®</sup> rules. They have become unwieldy, they are not succinct and they are inconsistent in many ways.

## 5. Mitigation and Conclusions

In the near-term, two main strategies are needed to mitigate the risks and costs identified in the use of Incoterms<sup>®</sup> rules in trade:

- A significant improvement in understanding of Incoterms<sup>®</sup> rules requires well-trained specialists in the rules and their application in industry, as well as detailed knowledge of international trade and logistics.
- The Incoterms<sup>®</sup> rules specialists must be empowered to choose Incoterms<sup>®</sup> rules strategically, which requires them to balance the logistics capabilities of the buyer’s and seller’s organizations over the route under discussion, choosing that Incoterms<sup>®</sup> rule which maximizes the buyer and seller capabilities to deliver goods to the customer in the most cost-effective way.

To achieve these, a company must acquire the services of professionals who are trained on Incoterms<sup>®</sup> rules in detail and well versed in logistics and trade. The first strategy addresses the risks found with individual rules (EXW, CPT, CFR, FOB, DDP, CIP). Whether that involves formal training for staff before they can choose Incoterms<sup>®</sup> rules, or the hiring of expert advice, the depth of understanding must be sufficient that these professionals can perceive and avoid the risky scenarios. Such trained professionals would benefit both the buyer and seller through lower risk and lower overall costs.

In the longer term, the industry should seize the opportunity to create improved Incoterms<sup>®</sup> rules that are consistent in design across the E, F, C and D rules, they should be simplified and made more flexible (see [Davis and Vogt 2021](#)).

### *Limitations and Future Research*

As an overarching analysis of Incoterms<sup>®</sup> rules and their risks to SCM writ large, this study addresses a significant gap in the literature. However, the nature of this study required that broad assessments be made using generic categories of failure that apply to any scenario. This leaves out failure modes that might not apply generally, but still present risk in specific cases. Additionally, the nature of this study means that the results provide awareness of where applications and failure modes intersect in the application of Incoterms<sup>®</sup> rules, but only generalized approaches to mitigation can flow from such a review. Interventions specific to each case will need to be adapted or created. Finally, the analyses of likelihood and severity are (as with most instances of FMEA) interpre-

tations that, while grounded in survey responses and general experience, are subject to improvement with better data and more experience.

Per these limitations, future research should take the categories of risk identified herein and explore specific scenarios within each with more fidelity, making more specific descriptions of the failure modes and more particular recommendations about mitigation in each scenario.

**Author Contributions:** Both authors made roughly equal contributions to all phases. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy and consent limitations during the gathering of data.

**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

This appendix contains examples of survey results that inform FMEA likelihood ratings for failure modes.

**Table A1.** Decision Maker for Incoterms® Choice.

	Purchase Contracts	Sales Contracts
Legal	10%	10%
Logistics	17%	20%
Not sure, or “other”	13%	17%
Procurement	56%	18%
Sales	4%	35%
Total	100%	100%

**Table A2.** Issues Reported with Incoterm® Choices.

Frequency	Sales Applies Incorrect Rule	Procurement Applies Incorrect Rule	Logistics Is Not Consulted on the Rule Used	Contract Cannot Be Executed (Due to Incorrect Rule)	Do Not Know Which Rule to Pick for Strategic Advantage
Never	4%	3%	4%	7%	13%
Rarely	14%	25%	12%	40%	31%
Sometimes	40%	34%	35%	38%	29%
Often	33%	30%	40%	11%	23%
Routinely	10%	8%	10%	4%	5%
Total	100%	100%	100%	100%	100%

## References

- Alexandridis, George, Manolis G. Kavussanos, Chi Y. Kim, Dimitris A. Tsouknidis, and Ilias D. Visvikis. 2018. A survey of shipping finance research: Setting the future research agenda. *Transportation Research Part E: Logistics and Transportation Review* 115: 164–212. [\[CrossRef\]](#)
- Ben-Daya, Mohamed. 2009. Failure mode and effect analysis. In *Handbook of Maintenance Management and Engineering*. London: Springer, pp. 75–90.
- Bergami, Roberto. 2013. Managing Incoterms 2010 risks: Tension with trade and banking practices. *International Journal of Economics and Business Research* 6: 324–38. [\[CrossRef\]](#)



- Bergami, Roberto. 2016. International Delivery Risks: The Case of Delivered Duty Paid in Australia. *Acta Universitatis Bohemiae Meridionalis* 19: 1–9. [CrossRef]
- Davis, Jonathan, and John Vogt. 2021. Incoterms® 2020 and the missed opportunities for the next version. *International Journal of Logistics Research and Applications*, 1–24. [CrossRef]
- Gaudenzi, Barbara, George A. Zsidisin, and Roberta Pellegrino. 2020. Measuring the financial effects of mitigating commodity price volatility in supply chains. *Supply Chain Management: An International Journal* 26: 17–31. [CrossRef]
- Hansen, Wiljar, Inger Beate Hovi, and Knut Veisten. 2014. Logistics costs in Norway: Comparing industry survey results against calculations based on a freight transport model. *International Journal of Logistics Research and Applications* 17: 485–502. [CrossRef]
- ICC. 2000. *Incoterms 2000: International Chamber of Commerce (ICC)*. Paris: International Chamber of Commerce.
- ICC. 2010. *Incoterms 2010: International Chamber of Commerce (ICC)*. Paris: International Chamber of Commerce.
- ICC. 2018. ICC | International Chamber of Commerce. [Online]. Available online: <https://iccwbo.org/> (accessed on 30 November 2018).
- ICC. 2020. *Incoterms 2020: International Chamber of Commerce (ICC)*. Paris: International Chamber of Commerce.
- Liu, Hu-Chen, Jian-Xin You, and Chun-Yan Duan. 2019a. An integrated approach for failure mode and effect analysis under interval-valued intuitionistic fuzzy environment. *International Journal of Production Economics* 207: 163–72. [CrossRef]
- Liu, Hu-Chen, Xu-Qi Chen, Chun-Yan Duan, and Ying-Ming Wang. 2019b. Failure mode and effect analysis using multi-criteria decision making methods: A systematic literature review. *Computers & Industrial Engineering* 135: 881–97.
- Lo, Huai-Wei, James J. H. Liou, Chun-Nen Huang, and Yen-Ching Chuang. 2019. A novel failure mode and effect analysis model for machine tool risk analysis. *Reliability Engineering & System Safety* 183: 173–83.
- Lorenc, Augustyn, and Małgorzata Kuźnar. 2021. The most common type of disruption in the supply chain-evaluation based on the method using artificial neural networks. *International Journal of Shipping and Transport Logistics* 13: 1–24. [CrossRef]
- Ramberg, Jan. 2010. *Guide to Incoterms 2010*. Paris: ICC.
- Sawant, Amit, Sonja Dieterich, Michelle Svatos, and Paul Keall. 2010. Failure mode and effect analysis-based quality assurance for dynamic MLC tracking systems. *Medical Physics* 37: 6466–79. [CrossRef] [PubMed]
- Shebl, Nada Atef, Bryony Dean Franklin, and Nick Barber. 2009. Is failure mode and effect analysis reliable? *Journal of Patient Safety* 5: 86–94. [CrossRef] [PubMed]
- Stamatis, Diomidis H. 2003. *Failure Mode and Effect Analysis: FMEA from Theory to Execution*. New York: ASQC Press.
- Stojanović, Đurđica, Jelena Ivetić, and Marko Veličković. 2021. Assessment of International Trade-Related Transport CO2 Emissions—A Logistics Responsibility Perspective. *Sustainability* 13: 1138. [CrossRef]
- Vogt, John, and Jonathan Davis. 2020. The State of Incoterm Research. *Transportation Journal* 59: 304–24.