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ARTICLE

Deceptive counterfeit risk in global supply chains

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ABSTRACT

The study investigates deceptive counterfeits in the global supply chains. It explores perceived sources of counterfeits, their impact and identifies risk mitigation strategies in Business-to-Business procurement. An online survey was used to collect data from 140 procurement professionals targeted at a national purchasing body and affiliated UK purchasing groups. The study findings show that counterfeit breaches are increasing, especially in low-cost spare parts, sourced from tier-two suppliers based in developing countries. Counterfeits lead to high costs, delays, lost sales, product recalls and even legal action. Network transparency, cost of quality and pre-supply evaluation approaches and supplier relationship management are the most effective mitigation strategies to overcome deceptive counterfeit risk in global supply chains. The study contributes to supply chain academics and practitioners' growing research interest in counterfeit risk.

KEYWORDS

Counterfeit risk; global supply chains; supply chain risk management; procurement

Introduction

Supply chains (SCs) have become geographically dispersed and complex, raising increasing issues with regard to the traceability and visibility of the products and services they exchange (MacCarthy et al. 2016; Revilla and Saenz 2017; Cao, Bryceson, and Hine 2020). Manufacturers and consumers face a growing issue with the provenance or authenticity of products exchanged through global supply chains. Counterfeiters increasingly have access to the same quality of technology used by Original Equipment Manufacturers (OEMs) (Stevenson and Busby 2015). However, on its own, the capability to produce seemingly high-quality components would not threaten global SCs. Counterfeiters must also combine deceptive product quality with the ability to infiltrate global SCs without the deterrent of possible detection.

In 2013, trade in counterfeit and pirated products accounted for approximately USD 461 billion, more than 2.5% of world trade (OECD/EUIPO 2016). This has risen steadily and stands at 3.3.% of world trade (OECD 2019). over the years, Counterfeits can be categorised into two types based on the consumer perspective, either as non-deceptive or deceptive products (Grossman and Shapiro 1988). non-deceptive counterfeits are those which consumers can easily differentiate, based on signals such as price, quality and nature of the sale (Engebø et al. 2017). In contrast, deceptive counterfeits are sold under similar conditions and comparable to that of the original (Grossman and Shapiro 1988). Recently the Chinese government uncovered counterfeit COVID-19 vaccines smuggled overseas (BBC 2021; CNN News, 2021). With its focus on professional B2B purchasing, this study investigates deceptive counterfeits, where the buyer receives no signals to indicate that the goods might be counterfeit. For example, when a consumer finds an expensive perfume for sale from a temporary stall at a backstreet market at a quarter of the retail price, there are sufficient signals for even the consumer who makes a purchase to buy with the knowledge that similarity of appearance to the original expensive perfume does not offer the authentic fragrance. In B2B markets, sometimes, the contextual signals concerning the veracity of products provided by the supply chain are high enough to dispel doubts – the appearance, the price and, above all here, the distribution (supply chain) faithfully imitate that of authentic products; hence these are deceptive counterfeits. According to Spink et al. (2013), deceptive counterfeits products are offered in the market as genuine to deceive the purchaser. Examples of such B2B deceptive counterfeits include electronic semiconductors used in US Navy Boeing P-8 Poseidon aircraft (The United States Senate Committee on Armed Services 2012), plastics used in Aston Martin's supercars (Klayman 2014), metal used on NASA satellites (Potter 2009), components of nuclear power plants (IAEA 2000) and several more.

Counterfeits threaten manufacturers, consumers and the public, as these products are unable to

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perform as intended (Wee, Ta, and Cheok 1995). Procurement is most often the entry point into the 'supply side', as this department/function is responsible for selecting and evaluating suppliers (Booth 2014) in Supply Chain Management. Therefore, the procurement process has a critical gatekeeper role to play in preventing counterfeits.

Counterfeit goods threaten a wide range of industries (and their customers) including automotive, electronics, aerospace, pharmaceuticals, media, and fashion (Berman 2008; Wilcock and Boys 2014; Bian et al. 2016). The quality of pharmaceutical products is difficult to assess, making them a most attractive sector for counterfeiters (Staake, Thiesse, and Fleisch 2012; De Lima et al. 2018). More recently, new internet-based distribution channels (platforms, e.g., Darknet and social media) have played an essential role in increasing the amount of illegal counterfeit sales (Buxton and Bingham 2015). Indeed, the general rise of e-commerce has been identified as the key driver behind counterfeiting growth, especially through B2B online marketplaces (Liang and Gai 2015). As globalisation in SCs increases, the potential scale and scope of counterfeit risk rises (Li and Yi 2017). However, the anticipated parallel rise in academic studies in this area has not been realised (Richter et al. 2017).

On the contrary, extant research on deceptive counterfeits occurrences, their impact on supply chains and how to prevent deceptive counterfeits in the global B2B SC market is scant. Interestingly, contingent marketing literature is dominated by studies on the perception and attitude of consumers towards counterfeit products (the demand side of counterfeiting), and by anti-counterfeiting strategies for brand managers (Roux, Bobrie, and Thébault 2016; Pueschel, Chamaret, and Parguel 2017; Kros et al. 2019). However, studies considering the counterfeit threat from a supply-side perspective are limited (Staake, Thiesse, and Fleisch 2009). Zhang and Zhang (2015) looked at counterfeiting in relation to SC structures. Although there are a few relevant studies (e.g., Li 2013; Li and Yi 2017), it is still to become a mainstream SC topic. Furthermore, the complicated risk profile involved in counterfeiting and the grey market is not fully explored from SC network or risk management perspective (Wald and Holleran 2007; De Lima et al. 2018; Machado, Paiva, and Da Silva 2018; Ghadge et al. 2012). There is an evident need for studies that examine counterfeit risk in terms of its origins, impacts and mitigation within the SC context. Extant academic literature appears to offer no discussion around the SC areas/functions that are most prone to counterfeits and are the entry point for how counterfeits enter global supply networks. Counterfeit risk represents a disruptive force to SC stakeholders including suppliers, manufacturers and distributors (Kros et al. 2019), and need careful exploration. Chaudhry and Stumpf (2013) state that counterfeit products should be detected further up the SC network. There are very few empirical studies that examine the origins of the counterfeiting threat or that propose mitigation strategies from a SC or strategic procurement perspective (Staake, Thiesse, and Fleisch 2009; Zhang and Zhang 2015; DiMase et al. 2016; Machado, Paiva, and Da Silva 2018; Kros et al. 2019). Therefore, the objectives of this empirical study are to:

RO1) Explore the perceived SC sources and impacts of deceptive counterfeits.

RO2) Identify mitigation strategies employed to overcome deceptive counterfeits.

This study contributes to this research gap by providing valuable insights into the sources, impacts and mitigation of deceptive counterfeits in the global supply chain environment.

The remainder of the paper is structured as follows. In section 2, a comprehensive literature review on counterfeit risk in global supply chains. Section 3 explains the research approach. Section 4 presents the data collected and addresses the two research objectives. Section 5 provides discussion and identifies several future research directions in the form of a series of propositions emerging from this study and concludes with limitations.

Literature review

Counterfeit risk in global supply chains

Counterfeit products are a significant threat, especially for the semiconductor and pharmaceutical industries. In 2015, the counterfeit pharmaceutical drug market alone was worth 200 billion USD (Wall Street Journal 2015). Counterfeits do not adhere to quality standards and are not supported by any (genuine) inspection report or performance history. A review of definitions for counterfeiting and counterfeit products from academic and industry (non-academic) sources is collated in Table 1.

Marucheck et al. (2011) identified key breaches of product safety relating to global sourcing (supply) of components relating to low cost and recent changes to the SC structure. SCs are vulnerable to the risks posed by counterfeits primarily because of the limited experience, both of the existence of counterfeit products (from seemingly reliable sources) and their potential adverse effects. Such effects include damage to brand image, loss of revenue, decline in product innovation, hazards to consumer health and safety and even fatalities (Stevenson and Busby 2015; Li and Yi 2017). Risk assessment in this area should focus on the sources and impact of counterfeit products, including the potential consequences of counterfeits' risks (Kleindorfer and Saad 2005).

Deceptive counterfeits appear to be original and are sold as a genuine part via conventional business

Table 1. Different definitions of counterfeiting and counterfeit products.

Definitions from Academic Sources		
Term	Definition	Reference
Counterfeiting	*'Any unauthorised manufacturing of goods whose special characteristics are protected as intellectual property rights (trademarks, patents, and copyrights) constitutes counterfeiting'.*	(Cordell, Wongtada, and Kieschnick 1996, 41)
Counterfeiting	*'an original product with a remarkable brand value worth copying already exists on the market. Its characteristics are copied into another product as to be indistinguishable from the original and sold at a lower price as if it were the original, whereas consumers are well aware of the difference between the two products'.*	(Eisend and Schuchert-Güler 2006, 2)
Counterfeit trade	*'trade in goods that, be it due to their design, trademark, logo, or company name, bear without authorisation a reference to a brand, a manufacturer, or any organisation that warrants for the quality or standard conformity of the goods in such a way that the counterfeit merchandise could, potentially, be confused with goods that rightfully use this reference'*	(Staake, Thiesse, and Fleisch 2009, 322)
Definitions from Industry Sources		
Counterfeit part	*'a product produced or altered to resemble a product without the authority or right to do so, with the intent to mislead or defraud by presenting the imitation as original or genuine'.*	(AIA 2010, 10)
Counterfeit item	*'a copy or substitute without legal right or authority to do so or one whose material, performance, or characteristics are knowingly misrepresented by the vendor, supplier, distributor, or manufacturer'.*	(IAEA 2000, 1)
Counterfeit material	*'Material whose origin, age, composition, configuration, certification status or other characteristics (including whether or not the material has been used previously) has been falsely reported by the misleading marketing of the material, labelling or packaging; misleading documentation, and any other means including failing to disclose information'.*	(MoD 2014, 3)

channels (Grossman and Shapiro 1988; Zhang and Zhang 2015). Interestingly, they may even conform to the standards of the genuine article in low-level testing (Stevenson and Busby 2015). No buyer would knowingly buy deceptive counterfeits for their organisation unless corruption and bribery were involved (Huang and Li 2015).

It appears that major disclosures of counterfeit breaches have been 'accidental or incidental' outcomes of a public investigation into a public spending issue, i.e., not the primary focus of the original investigation. This is certainly true of the defence and aerospace industries and, again, where there are clear threats to public safety, in the cases from the pharmaceutical, healthcare and nuclear industries. Several supplier organisations such as World Bearings or the Semi-Conductor Industry Association have set up specialist websites to highlight the risk posed by counterfeit items and to propose actions that can be taken when a counterfeit is discovered. Other practitioner organisations such as the Chartered Institute of Purchasing and Supply (CIPS) have web-based knowledge sections dedicated to this area, again highlighting how much more seriously practice has engaged with the [B2B] counterfeit issue than supply-side academics. Table 2 presents some of the publicly reported B2B deceptive counterfeit breaches classified by industry/sector.

In terms of impacts, counterfeits lead to high costs for the OEM in terms of delays, lost sales, product recalls, and even legal action. Counterfeits may cause severe consequences including loss of life, damage to brand image, loss of revenue, and various hazards to consumer health and safety, including fatalities (Spink et al. 2013; Stevenson and Busby 2015; Bian et al. 2016; Ding, Stevenson, and Busby 2017). The indirect costs include lost time and the goodwill of the buyer, negatively affecting buyer-supplier trust and thus the supply chain relationship (Ghadge et al. 2017). Industrial strategies on counterfeits in global supply chains include avoidance, detection, mitigation and destruction. Avoidance is the most cost-effective method, as it has the lowest cost of action and reaction. However, a significant problem with this strategy is ensuring total avoidance. The second approach is detection, which relies on testing raw materials and parts inputs that have high economic value or are of critical importance (Wilcock and Boys 2014). The third strategy, mitigation, can be described as preventing a counterfeit based on previous experience; therefore, it assumes a product or system failure has occurred through counterfeiting. Mitigation is, therefore, the riskiest strategy because not all the counterfeits may be caught (Stradley and Karraker 2006). It is important to isolate, record and then destroy counterfeits once they are discovered. A 100% destruction strategy prevents the possible future spread of that particular counterfeit and enables clear communication to other interested parties about that particular threat. Companies may also protect the reliability of their distribution channel by using certified stores (Zhang and Zhang 2015). Chaudhry and Stumpf (2013) provide a discussion on government, agency and company-led initiatives to fight back against counterfeit pharmaceuticals. The anti-counterfeiting approaches

Table 2. List of publicly reported B2B deceptive counterfeit breaches.

Industry	Firm affected	Year	Type of counterfeit	Impact	Source
Aerospace	NASA	2009	False titanium on satellite	Delayed launch by 3 weeks	(Potter 2009)
	NASA	2014	False analogue devices discovered	Failed to active seawater activated release system	(NASA)
	Boeing	2011	Deceptive semi-conductors	Found in ice detection modules supplied p-8 by a subcontractor	(The United States Senate Committee on Armed Services 2012)
	Prat and Whitney	2014	False titanium used in engines	Delayed F-35 production at a considerable cost	(Capaccio 2014)
	Lockheed-Martin	2011	false random access memory chips	used in C130J and C27J, heads up displays.	(The United States Senate Committee on Armed Services 2012)
	Lockheed-Martin	2011	Fake transistors in sea hawk helicopters	Effectively grounded the helicopter	*Ibid*
Automotive	Aston Martin	2014	Fake DuPont plastic	Recall 175,000 cars	(Klayman 2014)
Nuclear	South Korea	2012	False safety documents discovered	3 nuclear power plants were shut down	(Cho 2014)
Defence	Raytheon	2011	Fake memory cards in a thermal high altitude area defence system	12 million USD System rendered inoperable	(The United States Senate Committee on Armed Services 2012)
Pharmaceutical	NHS	2007	Fake drugs entered SC and given to patients	21,000 packs still untraced	(Kemp 2012)
	Zimmer, Inc.	2012	Counterfeit chips	Units affected went unexpectedly into lockdown	(USFDA 2012)

discussed in their study (ibid) include consumer education campaigns, company-led social media initiatives, verification of drugs through labelling technology, and authentication technology in ports and borders.

Research methodology

A questionnaire was developed to investigate the sources, impacts, and mitigation strategies associated with deceptive counterfeits in global supply chain environments. The research questions were designed following an iterative process to capture the critical aspects of deceptive counterfeits within a B2B context; these questions were developed based on extant literature from academic and industry sources. Primary data in the form of responses to the survey were collected using an online survey. The online survey link (via *SurveyMonkey®*) was sent to professionals working in the international procurement and supply field. These individuals were accessed via the CIPS, the UK's premier and global professional procurement and supply professional organisation. It has more than 200,000 members spread across 150 different countries (CIPS 2020). The study utilised the wider reach of the CIPS network and contacted members from affiliated purchasing groups. The online survey was sent to 1350 members via email and LinkedIn message. The survey link was live (collecting data) for three months (June-August) in the year 2016, and several reminders were sent to encourage participation. Participants were assured that their responses would be reported, ensuring complete anonymity and confidentiality in order to increase candidness and disclosure associated with counterfeits. In total, 156 responses were received by the close of the survey. Ultimately, 140 useable responses were collected for analysis in this study, eliminating invalid (which typically meant that the same rating for all questions had been given) responses. Revisiting survey responses found that 32 respondents did not complete the full survey. Although a 10.4% response rate is low, it is believed to be acceptable given the necessarily sensitive nature of the subject. Furthermore, similar past 'low-response' survey-based studies in SCs (e.g., Zhang et al. 2016; Pueschel, Chamaret, and Parguel 2017; Domingues, Sampaio, and Arezes 2017; Laari, Töyli, and Ojala 2017; Zimon and Madzík 2020) support the acceptability of the low response rate. Therefore, the sample size can be considered a good representation of B2B procurement organisations.

Data analysis

From the pool of 140 respondents, 28 respondents were from a strategic/tactical management level (e.g., SC manager, company director, general manager, etc.), 66 respondents were from an operational management level (procurement manager, coordinator, specialist, etc.). The remaining 46 respondents classified themselves as other (procurement consultant, purchase administrator, ledger clerk, etc.). The sample provided a mix of procurement respondent roles and a diversity deemed instrumental in capturing a holistic picture of the problem.

Figure 1 represents the breakdown of the renewable energy industry (including oil and gas), contributing close to 50% of the total responses. There was also a good response from other industry sectors such as services (9%), manufacturing-other (9%), semiconductors (3%) and healthcare/pharmaceuticals (3%). The annual procurement spends of the organisations are presented in Table 3. It is evident that the survey

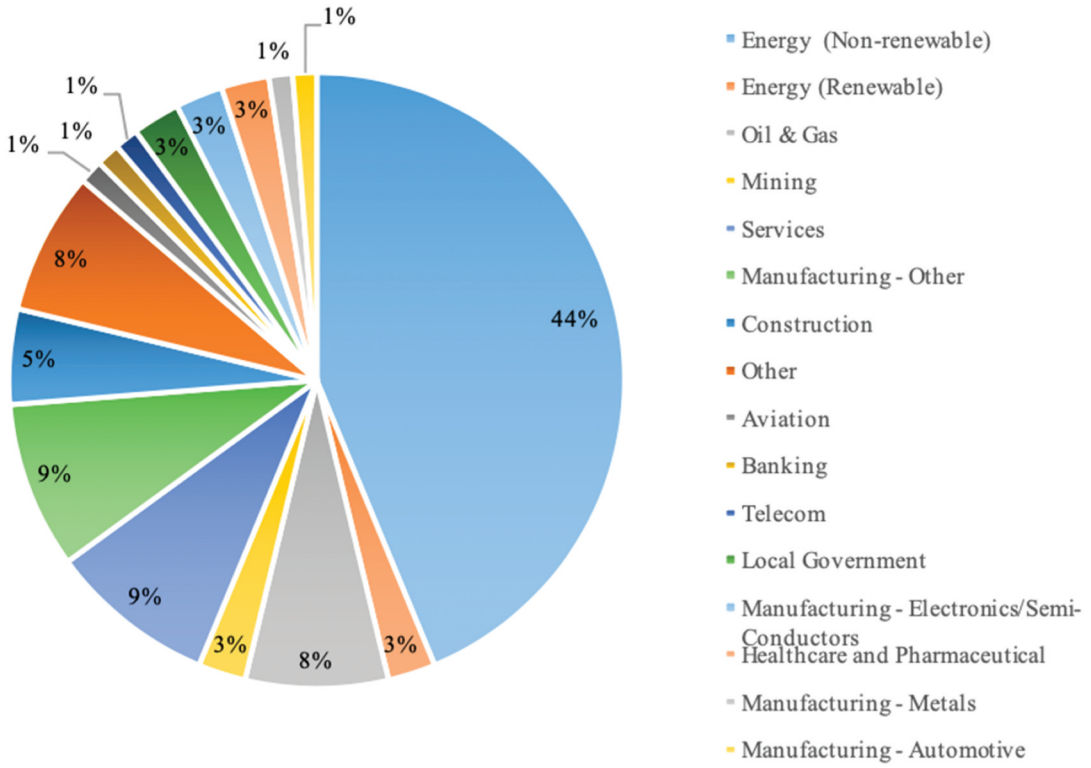

Figure 1. Breakdown of survey participants by industry.

Table 3. Annual procurement spend of organisations.

Annual procurement spend in USD	Percentage
30,000,000,000 < x	1%
20,000,000,000 < x ≤ 30,000,000,000	9%
10,000,000,000 < x ≤ 20,000,000,000	5%
1,000,000,000 < x ≤ 10,000,000,000	18%
500,000,000 < x ≤ 1,000,000,000	9%
100,000,000 < x ≤ 500,000,000	14%
20,000,000 < x ≤ 100,000,000	13%
5,000,000 < x ≤ 20,000,000	15%
x ≤ 5,000,000	10%
Blank/No answer	6%

covered small, medium and large-scale organisations sourcing/operating globally.

The responses were global, capturing operations and supply bases of various businesses from North America, Asia, the Middle East, Australia to Europe. Figure 2 represents the percentages of the geographic area based on the respondent organisations' operations and supply base. 46% of respondents indicated that their supply base was located in only one region, whereas 49% said that their supply base consisted of three or more regions.

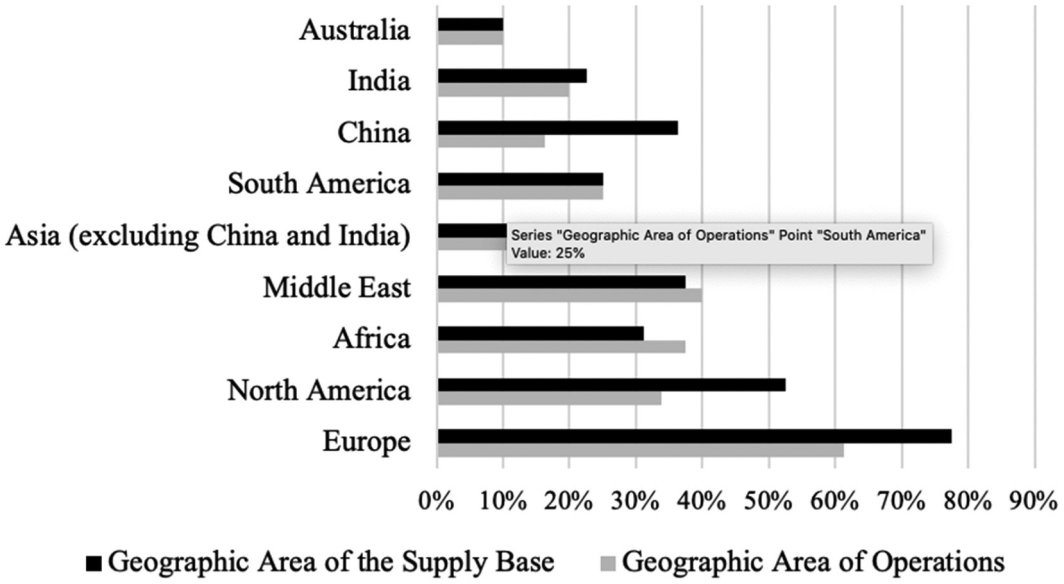

Figure 2. Geographic area of operations and supply base of the companies.

Counterfeit sources and impact

Supply-side occurrence analysis attempts to identify the nature and frequency of deceptive counterfeits, explore how they enter SCs, and identify consequences. With regard to investigating the number of counterfeit purchases, half of the respondents could not estimate the number of counterfeit purchases (per year) made by their organisation and did not respond to this question. The remaining 28% of respondents (mainly from non-renewable energy, oil & gas, manufacturing (all), and services industries) stated that approximately 1 to 10 purchases of counterfeits were made by their company in a year. Figure 3 shows the percentages of the total number of counterfeit purchases per year; only a small minority estimated that their organisation made over 20 counterfeit purchases per year.

Chi-square tests were applied to check whether there is a relationship between respondents' counterfeit experiences and their responses to various questions such as industry, job title, and operation area. A significant relationship was found between job title and counterfeit experience (Table 4). Although the ρ-value, 0.047, is very close to 0.05, analysis of the data shows that participants' level in the organisational hierarchy affects their experience of deceptive counterfeits. Most of the respondents from an operational level had experienced a counterfeit breach. This finding speaks about much repeated here sensitivity of the counterfeit issue; Are counterfeit episodes reported or are they effectively buried? Are senior management levels supportive of transparent reporting? Would reporting a counterfeit episode be career damaging; for example, echoing whistleblower and 'shooting the messenger' concerns? Without a culture of communication and reporting about counterfeit purchases the risk of sustained underreporting of counterfeits continues. This result highlights the importance of communication between different departments and levels of the organisation over counterfeit risks.

Table 4. Chi-Square test for the relationship between counterfeit experience and job title.

Parameters	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.658[a]	4	0.047
Likelihood Ratio	9.800	4	0.044
Linear-by-Linear Association	1.590	1	0.207

a. 1 cells (11.1%) have expected count less than 5. The minimum expected count is 4.60.

Respondents who had experienced a deceptive counterfeit breach (42%) reported that the occurrence was driven by deceptive quality and documentation. Participants were asked to select the region(s) that constitutes the largest source of counterfeits based on their experience. As shown in Figure 4, China was identified as the riskiest region, followed by Africa, India, and other parts of Asia (excluding China and India).

To explore how deceptive counterfeits breach SCs, survey participants were asked where they perceive counterfeits to be most prevalent. Regarding spend level, a large majority of the respondents that had deceptive counterfeit experience (71%), selected low-cost items as the most frequent source for the counterfeits. The remaining (29%) respondents stated that high-cost items are the most frequent counterfeit category. One respondent commented: *'Risks exist on tools and MRO purchases' (R69)*. Low-cost items, typically fall under the 'desirable' category of VED (vital, essential and desirable) product classification (Botter and Fortuin 2000), are likely to have a less rigid specification and be sourced from a larger pool of suppliers than high-cost items; companies have a 'brand' buying tendency for high-cost items. Also, suppliers of high-cost products are mostly OEM/OCM or larger enterprises. These suppliers' products are subject to higher scrutiny and quality inspection than the supplies of low-cost parts.

The survey responses also indicate that spare parts are perceived to be the most frequent source of counterfeits by the respondents that had a deceptive

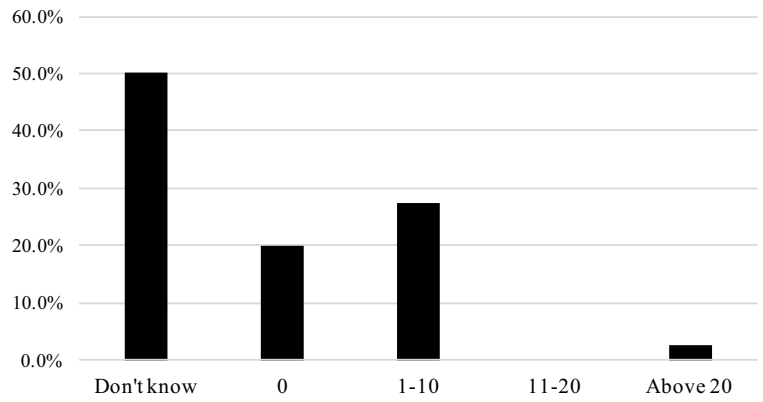

Figure 3. Number of counterfeit purchases per year.

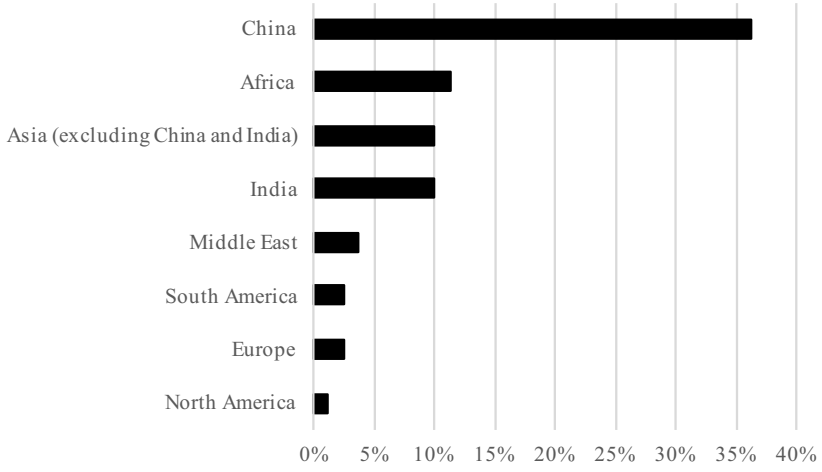

Figure 4. Largest source of deceptive counterfeits based on respondents' experience.

counterfeit experience. This finding was based on the respondents that have experienced deceptive counterfeits only. Among those counterfeit experienced respondents, 70% said that deceptive counterfeits are more frequent in spare parts, and 30% regarded original equipment as the most frequent source of deceptive counterfeits. Branded OEM products command a premium price, providing buyers with an incentive to find substitutes and potential counterfeiters with the incentive of large margins. According to the respondents, metals are the riskiest category of counterfeit products, followed by chemicals, bearings, semiconductors, and plastics.

A high percentage (64%) of the respondents with counterfeit experience complained about the availability of forged certificates and test reports for goods and equipment they purchased. Table 5 shows some of the examples of deceptive counterfeit SC breaches identified in the survey. The counterfeits in this table range from deceptive metal fittings to fake surgical tools to lifting shackles. These examples highlight the extensive range of goods that are counterfeited globally. Deceptive counterfeits occur with increasing frequency, and the majority of the examples in the survey have occurred in the year 2016. In both Tables 2 and 3, the relative cost of the reported counterfeit parts is low in comparison to total spend. This reinforces one of the findings of this study that counterfeits are most prevalent in low-cost items.

While the conventions currently governing the cost of quality include the cost of replacing a part and finding the source of the quality problem (Farooq et al. 2017), respondents were not able to estimate the direct financial implications of a counterfeit breach. Related participants responded *'Difficult to say. Anything from a few hundred dollars to millions, if it causes a malfunction' (R29), 'It could be catastrophic for critical parts' (R60), 'wide open . . . .in a drilling operation, the cost can be as much as 1.6 USD M per day' (R111).* '*more than a cost, higher implications for safety and security in our [aerospace] sector*'. The cost of a counterfeit episode is highly variable because it depends on the criticality and the value of the counterfeited product and how early the breach is uncovered and acted upon.

Figure 5 shows the percentages of the respondents' answers for the SC levels or tiers in which the counterfeits entered SCs. Nearly half of the participants indicated that counterfeits breached their SCs via their second-tier suppliers (Figure 5). This highlights the need for greater SC visibility; again raising the issue of the hidden costs of 'opaque' sourcing strategies.

Counterfeit risk mitigation

This section explores the most frequent anti-counterfeit strategies employed by procurement professionals. Further sub-questions aim to assess the effectiveness of these practices and determine the reasons for selecting these strategies. Figure 6 presents the 12 anti-counterfeit practices proposed by the CIPS.

Respondents were asked to select the most effective anti-counterfeit strategies based on their supply management experience. The three most common practices the survey responses identified were; i) high-level specification, ii) contract performance review and continuous improvement, iii) supplier relationship management and supplier contract management/development. The overlap between practices (ii) and (iii) reflects how different organisations group their activities in these respondent-provided descriptions. However, the predominant emphasis on contract management reflects how a critical responsibility of B2B purchasing functions underpins quality assurance and is, therefore, the front line for preventing any quality problems including counterfeits.

One of the respondents stated that '*the rest of the SCs can follow these specifications to overcome*

Table 5. Examples of deceptive counterfeit breaches identified in survey.

Type of Counterfeit	Year	Impact of Counterfeit	Industry
Deceptive metal fittings	2016	Loss of future sales	Non-Renewable Energy
Forged material certificates for drilling equipment	2016	Supplier blacklisted	Non-Renewable Energy
Mechanical (pump) spare parts	2015	Cost of 500,000 USD and all purchases from supplier stopped	Non-Renewable Energy
Tool shearing off down hole causing 3 days' worth of lost rig time	N/A	Contractual action taken; tighter QA/QC introduced	Non-Renewable Energy
Flanges were not of the quality expected as had been quoted in the vendor's proposal and stipulated on the Purchase Order	2012	N/A	Non-renewable Energy
Piping falsely labelled as 316 SS	2016	Banning of supplier and sub-suppliers	Non-renewable Energy
Lifting shackles	2007	This resulted in an extensive examination, testing process and business interruption	Non-renewable Energy
Fake cooling gas for large heat exchangers	2014	Emergency new purchase/fast track	Non-renewable Energy
Valves provided by a manufacturer were made using lower grade material and made in China even though the request was clear on materials to be used and where to be manufactured.	2016	Investigation ongoing	Non-renewable Energy
Purchase of surgical instruments	2012	We were using a long-standing well-established supplier whose quality systems had failed.	Healthcare
Steel was not to BS Standards	2016	None was caught internally	Construction
The vendor had embossed the marking on the steel pipe with a counterfeit certification. On investigating further, this was material from the Asian market, and our specification indicated other specific regions. On material analysis, it was found to be a lesser grade than that we required.	2014	The vendor was blacklisted, and a liquidated damage clause was applied.	Non-renewable Energy

counterfeits' (R42). The higher or tighter the quality specification, the more the purchasing function is constrained, and the number of potential suppliers reduced. Therefore, high-level specifications as a measure to deter counterfeits involve additional transactions costs for the firm and perhaps higher prices in choosing from a smaller pool of qualified suppliers; these costs have to be traded off against the costs of the quality of counterfeits. The second most effective practice is contract performance review and continuous improvement (CPR & CI). This strategy relates to post-contract award management. This response is different to iii) in its focus on continuous improvement – which as part of the quality process would involve suppliers committing to continuous improvements that would be beyond the capabilities of a counterfeiter and, therefore, could be a preventative mechanism when part of the contract.

The third most effective practice is Supplier Relationship Management (SRM) and Supplier Contract Management/Development (SCMD); *'keeps communication of issues open and visible' (R31), ' . . . enables us to switch strategic suppliers if a poor quality occurs' (R77), '.allows the buyer to engage with key suppliers at an early stage of the process' (R92), and ' . . . helps to understand our supply base better' (R2)*. SRM is usually associated with critical suppliers, as it is considered resource-intensive. Low-cost sources do not usually include SRM for that reason, but it is likely that SRM practices will differ within the sample, and the survey cannot comment on that with precision. Both SRM & SCMD and CPR & CI have emphasised QA/QC, providing a potential evidence base for a more sophisticated view of the costs of quality and improved anti-counterfeit quality assurance.

Counter-intuitively, although CPR & CI and SRM & SCMD are among the top three most effective anti-counterfeit practices reported, neither appear in the top three reported most frequently used practices. The complex structure of these activities makes it difficult to adapt and mitigate their deployment. Similarly, although evaluation of suppliers' tender/bid documentation, pre-qualification questionnaire and specification are among the top three most frequent practices, they are the seventh and sixth most effective reported practices, respectively, based on the survey responses. This indicates that despite their extensive usage, these practices are not perceived to be the most effective by the respondents. Yet, respondents place great confidence in the potential efficiency of such evaluations of a supplier's tender/bid: *'depending on exact nature of the method and verification mechanisms (e.g. auditing), at bid stage companies tend to be more compliant in terms of upfront reviews and verifications' (R10), 'it is crucial to know what your vendor is offering you and be confident of their SC', and 'careful evaluation will ensure their capabilities and compliance' (R82)*. These responses indicate that buyers' have confidence that pre-supply evaluation processes could cope with the counterfeit threat but that current practices need adaptation to be both effective as a deterrent and cost-effective as a solution.

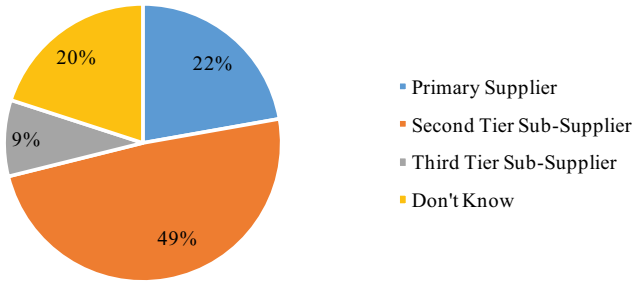

Figure 5. Level of deceptive counterfeit breaches.

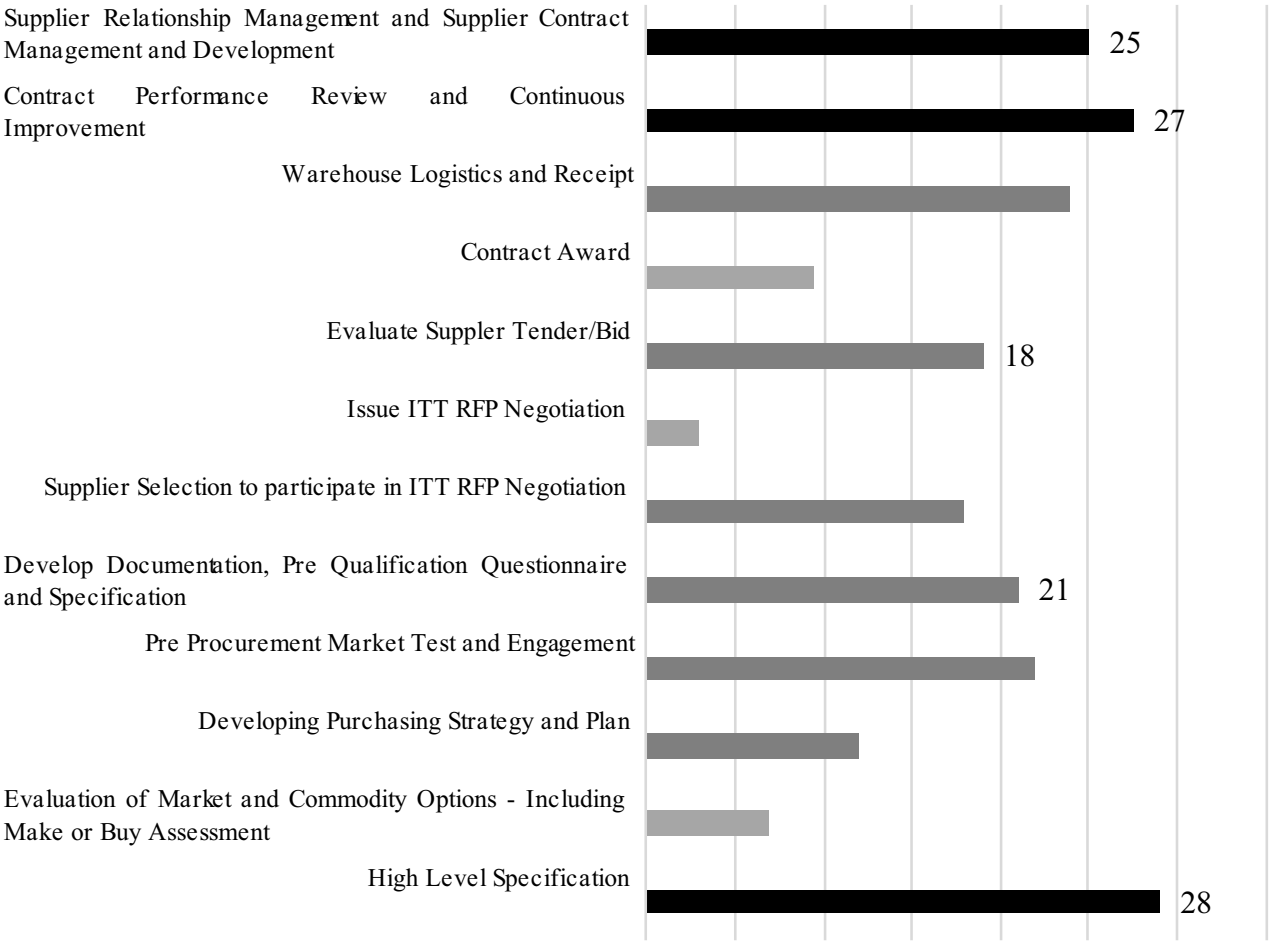

Figure 6. Frequency of anti-counterfeit practices.

Few participants came up with the rather run of the mill or stock proposal of '*additional training*' to increase organisational awareness regarding counterfeits as a mitigation strategy. Other responses were more reflective as follows: *'Undertake awareness sessions, raise the subject' (R53), 'Encourage more widespread sharing of examples across the industry' (R103)*, and *'Wider industry focus and sharing of information' (R11).*

Anti-counterfeiting campaigns, publications about counterfeit risk and examples from different industries, informative emails, improved communication and collaboration between different departments (e.g., commercial, legal, quality and technical staff), and development of a general framework for the sources and impacts of counterfeiting was also identified. A high percentage of the respondents emphasised the importance of training and information sharing about counterfeiting examples and cases encountered within organisations. Several respondents recommended developing common knowledge-sharing platforms to share counterfeit experiences and statistics for wider SC networks. The above findings are expected to benefit SC professionals in better managing counterfeit risks in global supply chains.

Conclusion

Discussion

This study addresses area of deceptive counterfeits in global SC environments. An online survey was conducted with international purchasing professionals from varying industries, supply bases and backgrounds, generating 140 useable responses. The research objectives behind the survey focused on understanding the sources of counterfeits, their frequency, the impacts of counterfeits and counterfeit mitigation strategies. Whilst the data were analysed following statistical approaches, and some statically validated insights were drawn, in the main, this is an exploratory study, the raw data of the responses are very much perceptual responses. Table 6 presents a summary of the findings.

What we have presented here is, we believe, an accurate presentation of the current state of deceptive counterfeits. However, that state or knowledge base is sketchy, anecdotal, unconnected, and lacking the validity that comes from knowledge sharing and thus open for debate.

Future research directions

In this section, the agenda for further research into deceptive counterfeits is provided. Given the diverse and amorphous state of academic knowledge in this area, this study sets out to create the future research platform through a series of concrete and cumulative propositions:

Table 6. Summary of the findings in terms of research objectives.

Research Objective	Findings
RO1: Explore the sources and impacts of deceptive counterfeits	– Low-cost items and spare parts are the most frequent counterfeits. – Majority of items originate from second-tier suppliers based in parts of Asia and Africa. – Counterfeit impact lead to high costs for the OEM in terms of delays, lost sales, product recalls, and even legal action.
RO2: Identify mitigation strategies employed to overcome deceptive counterfeits	– Network transparency to bring visibility beyond second-tier suppliers; additional QC/QA checks for products sourced from Asia and Africa low-cost countries. – Developing new cost of quality and pre-supply evaluation approaches. – The three most effective countermeasures found within the remit of purchasing are as follows; i) high-levels of specifications, ii) contract performance review and continuous improvement, and iii) supplier relationship and contract management/development.

(P1) The random way in which deceptive counterfeits are discovered suggests there are many more in use than estimates identify to-date.

It was found that, typically, counterfeits are not discovered by deliberate techniques such as audits; this suggests there may be many more in B2B use than previous estimates suggest. This proposition is also supported by those working at operational levels reporting more counterfeit episodes than more senior levels. Future research can look into capturing deceptive counterfeit risks in global supply chains.

(P2) Many deceptive counterfeits appear to offer an acceptable level of quality

This is a debatable proposition, yet it builds on the logic in P1 above. It is also supported (indirectly) by the consumer-facing marketing literature on counterfeits. Consumer counterfeits, often with clear counterfeit signalling – very low price, and a 'down market' channel – continue to sell; somehow, they offer an acceptable level of quality (Wilcox, Kim, and Sen 2009). Some professional buyers may, indeed, be aware that they are purchasing/using counterfeits, in which case the 'deception' is between that organisation and its SC, which goes beyond the sophistication of the data. There is an evident need for robust data to better understand deceptive counterfeits.

(P3) Underreporting will continue until there is a major incident that energizes key stakeholders to demand greater transparency.

The fact that those working at operational levels report more counterfeit episodes than more senior levels is used, again, to support this proposition. This pattern of risks hidden in the SC and only being exposed by one tragic event has been seen before, notably with high street clothing retailers and brands.

(P4) The assumption within current practice and supply chain literature is that counterfeiters are motivated by short-term profit. Counterfeiters motivated by long-term profit (e.g., disruptive innovators) and not-for-profit counterfeiters (NFPC, e.g., politically or ideologically driven) may have different objectives, use different tactics, and pose different risks.

The assumptions apparent in the responses to this survey suggest a rather one-dimensional, or at least firm by firm, approach to deceptive counterfeiting than, say, that of a joined-up, knowledge-sharing network. Of particular interest here is how counterfeits could be used to destabilise a company/brand/market/segment or even nation is an important unanswered question; for example, by creating so much confusion and doubt (the 'fake news effect) that buyers lose trust in accepted sources and are more willing to 'experiment'. Such approaches could easily be

combined with a much longer-term counterfeiting perspective than is currently considered, e.g., counterfeiters could provide a high-quality product that would last beyond short-term expectations (also lulling users into a false sense of security).

Limitations of the research

All research has limitations, and some of the key shortcomings of this study are presented here. Being a survey-based study limited its generalisability but brought out some useful inferences in the global supply chain context. The true cost of counterfeits is not currently taken into account in costs of quality calculations regarding low-cost sourcing decisions. One of the limitations of survey data is the loss of detail and richness. The low response rate on survey is another limitation. Future study can explore the grey market, corruption, compromised safety/quality standards in the context of counterfeit risk. Such analysis could then feed into where B2B deceptive counterfeits are most prevalent, now, and where they are likely to occur in the future; a further critical issue is for research to assess the extent to which the counterfeit industry is a response to cyclical economic conditions or a more permanent threat.

Disclosure statement

No potential conflict of interest was reported by the authors.

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