Unveiling the Black Markets of Pooled Assets

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Abstract

Presence of black markets is not common for every industry but is a unique phenomenon in the industries such as asset pooling and leasing services. The unique business models and the asset flows that we see in such industries are susceptible for such threats and reveals the nature and extent of extent of industry-specific threats. This paper employs agility lens (Overby et al. 2006; Roberts and Grover 2012) to understand how such firms could address the issue of black market threats with the help of network structure. Through a case study of a global asset pooling and leasing company, we reveal the criticality of network structures, the difficulties, inadequacies and impracticalities of current tracking technologies that challenge firms in minimizing such threats.

Keywords: Black markets, Network structures, asset pooling, impact of IT, responding

1 Introduction

In present-day hyper competitive business environments, firms need to sense and respond quickly to dynamic changes in business environments. This has become a strategic imperative for contemporary organizations (Atapattu & Sedera, 2014; Overby, Bharadwaj, & Sambamurthy, 2006). However, possessing sensing and responding capabilities is inadequate for achieving competitive advantage. Rather, organizations need to strongly match the sensing capabilities with the responding capabilities to become significantly dexterous in combating precarious and competitive conditions (Roberts & Grover, 2012). Extant literature on enterprise agility has predominantly focused on sensing and responding to opportunities (Chakravarty, Grewal, & Sambamurthy, 2013; Roberts & Grover, 2012) while innately ignoring its criticality in addressing threats. Also, studies on agility in the Information Systems (IS) discipline are mostly fixated on demonstrating the sensing-responding capabilities of firms for opportunities and on how firms could optimize their performance (Sambamurthy, Bharadwaj, & Grover, 2003; Saraf, Christoph Schlueter, & Gosain, 2007). In the process, research on sensing and responding to threats has received less attention. We are thus motivated in investigating industry-specific threats and how firms sense and respond to such threats through value network structures and by integrating information technology (IT) into business functions. Collectively, sensing and responding to threats provide a novel way for achieving agility in addressing risks and reducing the imminent dangers to businesses. In such threat-based scenarios, a lack of agility is evident from negative firm performances such as revenue losses.

2 Threats

Threats are defined in myriad ways such as coercive acts eliciting negative outcomes that intend to inflict harm or loss[1]. They are also described as risks indicating approaching or imminent dangers, events or the likelihood of events occurring that have negative consequences such as loss or damage to life and property. Threats are also seen as acts

[1] http://en.wikipedia.org/wiki/Threat

(malicious or otherwise) that breach the security parameters of systems such as a computer or a social environment through know or unknown vulnerabilities. Such acts are enforced through communications or threatening behaviours that force compliance, restrict the freedom of others, inflict harm or damage property[2]. As an "expression of interest to harm or act out violently against someone or something, it (threats) can be spoken, written, or symbolic". These can be caused by factors internal to the organization or triggered by external factors in the environment (Hill & Westbrook, 1997). Thus, threats are malicious things, risks, acts, occurrences or elements that may or may not exist or happen but have the capability and potential to impose or cause harm or damage and other negative outcomes[3] (Meier et al., 2009).

Threats are not created equally. As an "expression of intent to harm or act out violently against someone or something, (threats) it can be spoken, written, or symbolic" (Jimerson, Brock, & Cowan, 2005). They are characterized by three key components:

(1) **Types**: a *direct threat* is a specific act or occurrence against a specific target (e.g. property, people, organization, environment) and happens in a clear, explicit and straightforward way. In comparison *indirect threats* are vague, unclear and inconspicuous that are tentative and suggest negative or violent occurrences. A *veiled threat* is strongly implied or threatened but may not explicitly happen whereas a *conditional threat* is a warning of a malicious or violent act that could happen if terms or conditions are not met

(2) **Levels**: A *low* level is suggestive of minimal risk where the incidence of occurrence is vague, lacks detailed information and realistic probability. In comparison, a *medium* level is more direct, potential and probable where a general indication of its potential occurrence is more certain and realistic. A *high* level poses a direct, credible and imminent danger of its occurrence. This level is indicative of the threat being clearly known and predictable through historically observed and recurrent patterns of occurrences. A *very high* level of threat is well-defined and expected to occur based on prior analysis of conditions and factors that strongly suggest its occurrence

(3) **Extent**: The extent of a threat is generally based on the vulnerability of the target (e.g. organization, people, property, environment) in countering the impact of the threat. A *devastating* impact is where the threat causes large-scale destruction completely destroying the target beyond habitable use or restoration. In comparison, a *severe* impact denotes damage caused by the threat, which is serious but sustainable. In such cases the target is susceptible to damage but remains intact and can be rebuilt or reorganized. A *noticeable* impact is where the threat temporarily disrupts the target causing minimal damage. In such cases, the target is able to sustain through short periods of interruptions. A *minor* impact causes no significant damage to the target other than creating heightened awareness of the threat and initiating risk assessment exercises and analyses (Renfroe & Smith, 2011).

This paper investigates the unique threat of black markets related to pooled assets. Pooled assets refer to the shared use of high quality durable assets such as farming tools, truck trailers, and equipment used for hauling, storing and transporting goods (e.g. wooden pallets, metal containers) by multiple clients that hire or rent such assets. However, pooled assets such as wooden pallets or metal and plastic containers are highly susceptible to leakages from their asset lease pools due to pilferages or negligence in handling the assets by network partners. When pooled assets trickle from their lease pools into ungoverned locations such as open farmers markets or storage yards of small-scale retailers, the identity of the assets together with their geographical locations, movements and use remain concealed and do not get reported to the leasing company. The assets then either idle or are used free of costs by people and organizations that are not connected to the leasing company. We term such locations

[2] http://www.businessdictionary.com/definition/threat.html
[3] http://www.techopedia.com/definition/25263/threat

collectively as black markets of pooled assets. Such black markets can be termed as *veiled threats* to asset pooling and leasing companies (APLCs) and pose *moderate to high risk*. The *collective impact of this threat* over a period of time is considered *significant and severe*. Thus, this research specifically investigates:

(1) How black markets of pooled assets are formed?

(2) What is the impact of a black market of pooled assets on firm performance?

(3) What are the inadequacies of information technologies in responding to the threat of black markets of pooled assets?

This study is scoped to investigate the threat of black markets in a unique business-to-business (B2B) scenario, where (i) pooled assets such as wooden pallets are not sold but leased to various clients, and (ii) there is no collective enforcement (e.g. IT-enabled solutions, management strategies) for identifying, restraining or dismantling such black markets.

3 Asset Leasing and Pooling

Asset pooling and leasing companies (APLCs) offer assets on lease through a structured network of clients that form an asset lease pool. The ownership and control of assets in such lease pools is retained by the APLC. The operationalization of a leased asset pool is illustrated in Figure 1, wherein for example, APLCs lease metal containers to manufacturers who use it for storing and transporting goods to their wholesalers and in turn pass those back to APLCs after using it (refer Pool A in Figure 1). Similar pools exist for other leased assets such as reusable plastic containers (refer Pool B in Figure 1) and wooden pallets (refer pool C in Figure 1).

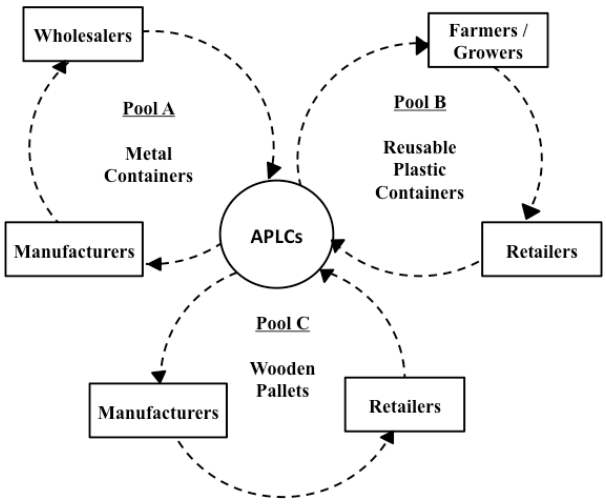

Figure 1. Asset Lease Pools

Pooled assets constitute a strategic option for network partners (e.g. manufacturers, retailers, wholesalers and service providers) in an asset pool because pooled assets (a) reduce capital expenditure incurred on owning the assets (b) decrease risks and costs associated with asset repairs and replacements (c) lessen the burden for ensuring environmentally friendly impacts of storing and servicing the assets, and (d) increase the potential for generating revenues. The benefits of pooled assets to network partners in a leased pool are explained in Table 1.

Types of Benefits	Description (Benefits accrued by network partners)
Cost reduction (Capital expenditure and related costs)	No capital investment is required for acquiring and maintaining the assets including for information systems in tracking asset movements; firms only pay for the assets used; asset pooling helps in reducing storage, handling and loss of the assets.
Risk reduction (Asset repairs and replacements)	Network partners do not repair or replace the assets; there is certainty of supply, which reduces the risk of production downtime; there is no obsolete equipment and therefore has no impact on the balance sheet of the organization (e.g. asset depreciation).
Waste reduction	Asset pooling reduces environmental waste, as pooled assets do not require packaging and related accessories.
Revenue increase	Pooled assets enhance the value and operability of existing goods and services, which in turn increase the competitiveness of goods and services and achieve best market price.

Table 1. Benefits of Pooled Assets

Pooled assets are however, highly susceptible to leakages within their asset lease pools due to pilferages or negligence in handling the assets by network partners. For example, a transporter may forget to pick up some quantities of wooden pallets used in transporting goods from suppliers to sellers in an open farmers market. When pooled assets trickle from their lease pools to ungoverned locations such as open farmers markets or storage yards of small-scale retailers, the identity of the assets, geographical locations, movements and use remain concealed from the APLC that leased them in the first place. We term such locations collectively as *black markets* of pooled assets. Assets in such black markets either (i) flow through illegitimate 'black pools' where non-clients of APLCs (e.g. small-scale grocery shops, transporters) freely use the assets without paying rent to APLCs while ensuring that assets do not enter official lease pools or (ii) re-enter the official lease pools incognito to both, APLCs and their client networks and adversely impact APLCs, which is indicated by the accumulation of rental revenue losses over time.

4 Threat of Black Markets of Pooled Assets

Black markets such as the ones described above are distinct veiled threats specific to the asset pooling and leasing industry. Such threats are compounded by the (i) uniqueness of the industry where client networks do not own the pooled assets but merely lease them from APLCs and pass the assets over to other clients in the network after using them. As a result, they take no responsibility for ensuring that assets remain in the lease pool and do not leak into black markets (ii) difficulty in assigning a unique identifier to an individual asset. For example, millions of similar color and type of containers (e.g. plastic and metal) are used daily for storing, hauling and transporting goods (iii) high volume of assets pooled and leased (iv) degree of difficulty in implementing technological solutions for tracking asset movements due to the rugged nature of the asset (e.g. wooden pallets) and additional costs of procuring and implementing IT for tracking simple low cost assets (e.g. the average price of producing a wooden pallet is about $25), and (v) slow and sometimes erroneous reporting of asset stocks by client networks, which makes it hard for APLCs to track asset flows and quantities in real time.

We focus on pooled assets because we are intrigued by (a) the high demand for simple yet highly robust assets such as metal and reusable plastic containers and wooden pallets (b) the degree of difficulty in making large quantities of such assets individually identifiable (c) the process of assets leaking from legitimate lease pools to black markets (d) challenges in tracking assets that leak from lease pools to black markets, and then re-entering the lease pool (e)

accumulation of revenue losses due to assets re-entering the lease pool incognito from the black markets.

5 Asset Flows and Network Structures

Pooled assets generally move in lease pools in two different ways: (1) Bi-directional flow (dyadic network): APLCs lease assets to different clients that use them and after using the assets return them back to the respective APLC for servicing or repairs (refer Figure 2. A), and (2) Unidirectional flow (complex networks): Assets such as wooden pallets flow between multiple clients without moving back to the APLC unless the assets require immediate repairs or servicing. In such scenarios, the assets are either (i) transferred between different client locations (e.g. large retailers hire pallets for carrying goods when delivering them to various stores) or (ii) transferred between different clients and their locations (refer Figure 2. B). For example, a farmer hires plastic reusable containers from an APLC to deliver fruits to wholesalers, who in turn use the same containers to deliver the goods to various retailers that in turn use the same to deliver goods to their various stores. In this type of asset flow, assets move between network partners for an indefinite period of time. Assets are returned to APLCs if the network partners (clients of APLCs) find that they have excess stock or assets require servicing, replacements or repairs. Black markets for pooled assets originate specifically during the unidirectional flow of assets wherein assets leak from the lease pool comprising a large network of clients and other value partners (e.g. transporters).

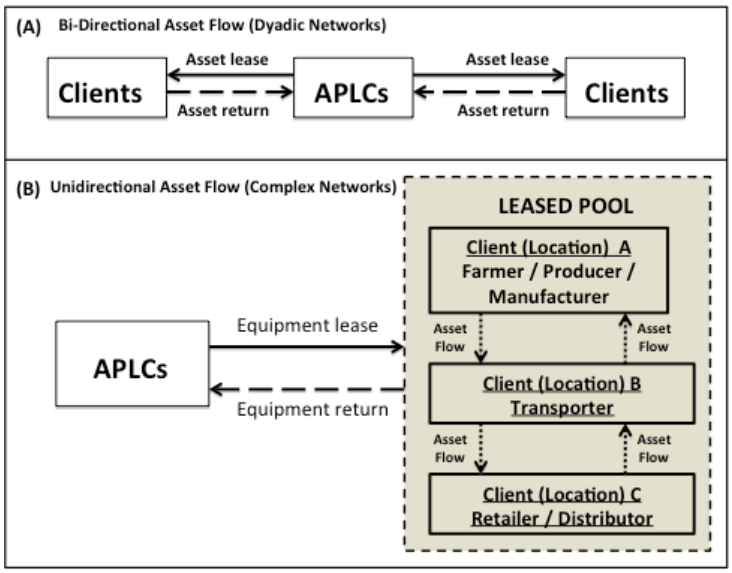

Figure 2. Network Structures and Asset Flows

5.1 Characteristics of Network Structures in Lease Pools

The attributes of network structures in lease pools are derived by understanding the network's architecture, which is conceptualized through (a) nodes comprising the networks (b) ties connecting the nodes, and (c) patterns and relationships resulting from the connections between nodes. Such network architecture is associated with the "characteristics, identities and number of nodes; location, content and strength of ties; and the patterns of interconnections among nodes" (Ahuja, Soda, & Zaheer, 2011). Network structures change, dissolve or modify with time. So, their evolutionary patterns are derived through basic factors that influence and shape the ties and nodes in the network. Based on the above, we characterize network structures in lease pools through the following elements.

(1) **Agency**: This is described as motivations and abilities of APLCs to shape relationships and form beneficial links or discontinue unprofitable ones with network partners (Sewell, 1992). APLCs are highly motivated in creating, improving and retaining client networks and partners for commercial gains. However, the concept of agency between

nodes (i.e. clients comprising network partners) is rather passive because the motivation for retaining ties within network partners is only for using pooled assets rather than fulfilling financial goals.

(2) **Opportunity**: This reflects the structural context of actions where network partners prefer to be linked within groups (than be left out) in order to benefit from activities that flow within the network. For example, wholesalers prefer to be linked with transporters that not only provide (i.e. pass on) pooled assets to them but also transport the wholesalers' goods to retailers (e.g. transporting goods on pallets). Therefore, by linking to a value partner in the network, a wholesaler not only obtains a pooled asset but also additional services such as delivery and logistical support. Such opportunities are available to all parties in the network.

(3) **Inertia**: This includes pressures for change by reflecting the "durability of structures and processes" that influence and restrict the focal firm's actions (Ahuja et al., 2011). For example, actions or activities by network partners in lease pools to collectively implement or disapprove IT solutions for managing the assets can influence or restrict the actions of APLCs.

The unique nature of the asset pooling and leasing industry and its network structure and the high voluminous uptake of pooled assets (e.g. about 40 million wooden pallets are leased in Australia each year)[4] pose two elusive challenges to APLCs. First, there is a perennial leakage of pooled assets from lease pools to black markets (i.e. ungoverned locations such as open markets). In such cases, the assets are deemed lost although they potentially re-enter lease pools incognito. Lost or idling assets in black markets do not adversely affect the revenue stream of APLCs, as clients generally compensate the loss. However, assets from black markets re-entering the lease pools pose huge problem for APLCs. First, the assets are not individually identifiable making it difficult for network partners to know their origins. As a result, the network partners use the assets, intentionally or unintentionally. In such cases, APLCs lose future accruable rental revenues although the assets are used within and outside of lease pools. Second, APLCs need data from their networks to track and plan asset movements and quantities, which are based on information flows from clients. However, the expected level of responsiveness from certain businesses such as for instance those involved in farming are deemed low due to (i) lack of data and asset management systems (ii) differing levels of literacy (iii) undisciplined approach for stock and asset checking and (iv) lack of expertise in compiling and communicating information digitally.

6 Research Design

In order to capture the richness of our research topic and understand how black markets are formed and their impact on APLCs, we investigated a global firm specialized in asset pooling and leasing services. This provided a grounded approach for understanding how firms engage in responsive actions for countering risks and threats to their businesses. It also helped our study in exploring radical changes that firms make to their existing capabilities (e.g. technologies) when responding to perceived threats.

6.1 Case Organization

Our case organization (referred hereafter as AP&L Inc.) is a global asset pooling and leasing company with over five decades of experience in pooling and leasing assets. It leases different types of assets (e.g. plastic reusable containers, wooden pallets) in over 50 countries, and employs more than 10,000 employees spanning over 1,000 locations including their service centers. On a global scale the company had revenues over US$5 billion (as on 30 June 2012). AP&L Inc. provided an excellent setting for capturing the inherent feasibility of present-day technologies in addressing the threat of black markets of pooled assets.

[4] http://www.ibisworld.com.au

7 Findings

Based on interviews with senior executives of AP&L Inc., and information collected through industry-related reports, we found that a critical attribute of sensing the threat of black markets of pooled assets was in understanding asset flows and their vulnerability to leaking from lease pools into potential black markets. AP&L Inc. endeavored to sense the threat of such black markets through timeliness and accuracy in sharing and communicating asset flow information within their client networks. We also found that responding to the threat of black markets of pooled assets involves taking pervasive actions, collectively as a network, to reduce its negative impact on business. This involves (i) reducing asset leakages (ii) recovering lost assets, and (iii) tightening information flows within the network structures. For AP&L Inc., responsive actions for addressing black markets revolved around implementing IT-enabled tracking solutions. However, it was found that to achieve this, nodes within network structures needed to be ready, collaborative and closely linked to the same objectives of eliminating black markets. Integrating the network structures through a feasible IT solution was (and is) deemed the best way to tackle the black markets of pooled assets.

Asset Tracking: For AP&L Inc., asset tracking and recovery is extremely important, as it affirms that their assets are performance worthy and safe as well as identifiable at locations where they are susceptible to enter the black market. In this regard, some of core issues that AP&L Inc. face are (a) the unidirectional nature of the lease pool wherein pooled assets moves between several locations and clients make it susceptible to pilferage, misuse and theft and (b) the equipment itself, which in several instances is not individually identifiable (e.g. containers, pallets) goes through volatile and rapidly changing situations and environments accruing wear and tear. Asset tracking is a challenging task faced by the company given the complexity of how revenue losses accrue due to asset leakages and specifically those that re-enter the leased pool and remain unidentifiable and unaccounted. As the average cost of producing a pooled asset such as a wooden pallet is low (approximately A$25), embedding any identifiable coding mechanism increases the leased value of the asset substantially. In addition, other mandatory related costs incurred in developing IT infrastructures are significant, which client networks connected to lease pools are generally unwilling to share. The rugged nature of pooling assets (e.g. wooden pallets) make it difficult to embed any type of IT enabled system-readable code including sophisticated radio frequency identification (RFID) tags. Due to the high number of pooling assets in operation (e.g. about 40 million wooden pallets are leased in Australia each year)[5] implanting any individually identifiable materials on them is an expensive and time-consuming task. In addition, any IT initiatives undertaken by the company also require network partners (e.g. warehouse staff, transporters) to adopt and use the technology, which can be rather daunting given the differing levels of literacy, time and resource availability of the network partners.

> "We give the assets (equipment's) on lease. We don't pass the ownership at any point. We are no different from a rental car company."
>
> "We encourage customers to keep the assets (equipment's) as long as they want. The more they have it, the more rent we receive."
>
> "We don't sell assets (equipment's). We own a pool."

Quotes A

[5] http://www.ibisworld.com.au (Pallets and Other Wood Products Manufacturing in Australia)

8 Formation of Black Markets of Pooled Assets

A black market is formed when assets leak from lease pools either through deliberate action (e.g. pilferage, theft, vandalism) or unintended behaviors such as forgetting to transport (i.e. return) empty pallets or leaving behind a few pallets in less regulated locations such as open markets. In such situations, AP&L Inc. deems the assets as lost and requisite compensation from their client. When assets flow into the black market (i.e. non-governed places such as the backyard of a retailer or trucker or open farmer markets) they idle or somebody eventually picks them up and begins to use them. Assets picked from the black market are used for individual purposes through a black pool where AP&L Inc. has no control or knowledge of the assets although they own the assets. Also, the finder of the assets in black markets either uses the assets without informing AP&L Inc. or sells them to other interested parties.

Alternatively, those picking up idling assets in black markets sometimes return them to businesses that may or may not be clients of AP&L Inc. This scenario is of utmost concern to AP&L Inc. because assets re-entering the lease pool may not provide any rental revenues to AP&L Inc. if they are not reported as having come from a black market. This happens because clients may not know the origin of the assets, as they are not individually identifiable (e.g. wooden pallets). When a large number of assets re-entering the lease pool from the black market go unnoticed by AP&L Inc. but remain in active use within the lease pool, they begin to accumulate rental revenue losses for AP&L Inc. We depict a scenario to understand the formation of a black market of pooled assets, the eventually re-entry of the leaked assets into the leased pool and the impact on the revenues of AP&L Inc.

8.1 The Scenario

AP&L Inc. issues assets to Client A – generally a farmer, producer or a manufacturer. Client A then uses the assets and in turn passes it on to Client C – generally a retailer or distributor through Client B - generally a transporter. Within this movement some quantities of the assets potentially leak out and end up in less governed places such as the backyard of another retailer or in a corner shop storage area or an open farmers market or in the yard of the transporter (trucker) (which may not be a client of AP&L Inc.). In addition, idling assets are also prone to be picked up by other parties either intentionally or unintentionally. When assets leak out from the lease pool in this manner, they accumulate over a period of time into a substantial pool or black market. Refer Figure 3 and Quotes B.

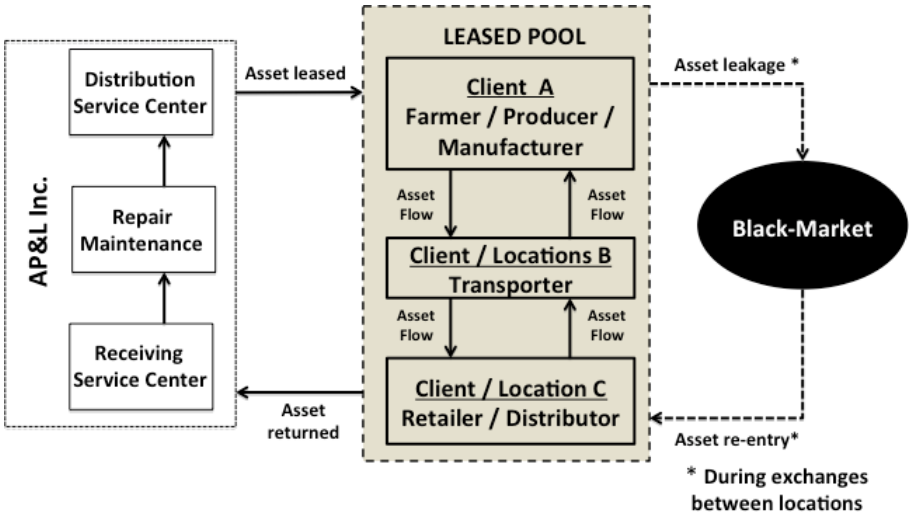

Figure 3. Asset Leakage and Formation of Black Market of Pooled Assets

> "Black pool is a big pool in millions of dollars (of) lost revenue."
>
> "We lose them (assets) in less governed places like markets, farmers, grocery stores, which are not our accounts."
>
> "(We do) not necessarily lose revenue if assets (assets) are idling because they (clients) are paying money for not using it."
>
> "We don't have visibility any more (assets) and we have given it up"
>
> "We have no knowledge of where our assets are."

Quotes B

8.2 Impact on AP&L Inc.

Assets leaking from the lease pool, their subsequent re-entry into the lease pool and the impact on AP&L Inc.'s revenues is now explained through the below scenario.

Impact 1: When a company C that is not a client of AP&L Inc. realize that they have lost some assets, they inform client-B of AP&L Inc. (from whom they received the assets) and offer compensation. In turn, client-B informs client-A and passes the compensatory amount. Client-A realizing that it has lost some assets quantities informs AP&L Inc. and passes the compensatory amount for the lost quantities to AP&L Inc. In return, AP&L Inc. replaces the lost asset quantities with new quantities. So, the contractual agreement between AP&L Inc. and Client A remains unaffected, which in turn maintains the revenue stream (refer Figure 4. Impact 1-Compensation). However, the lost assets are susceptible to be utilized elsewhere knowingly or unknowingly. Hence, AP&L Inc. loses potential rental revenue.

Impact 2: Some of the previously lost quantities of the asset (from the black market) now re-enters the lease pool (at some point in time) and end up with client-D through a transporter (company-E) who might not be a client of AP&L Inc. Client-D finds excess asset quantities in their premises and presume them to be surplus stock (not knowing that it has come from the black market). So, they send some of the quantities back to AP&L Inc. requesting *a reduction to their original contracted asset stock*. By *doing so, client-D ends up paying less rental revenue for the asset although they have the same quantities of the asset originally contracted*. Therefore, the actual asset usage by client-D does not reduce. But, they end up paying less rent for their original stock in use. In this scenario, AP&L Inc. loses future revenues because it continues to receive less rent from client-D (refer Figure 4. Impact 2 – Excess Assets Returned). Refer Quotes C.

> "(The) challenge is we don't know whose equipment's are coming back. One-on-one correlation in a dynamic supply chain is hard to make."
>
> "When equipment's are lost somebody will have that (equipment). It (the equipment) may come back to the pool but without paying rent."

Quotes C

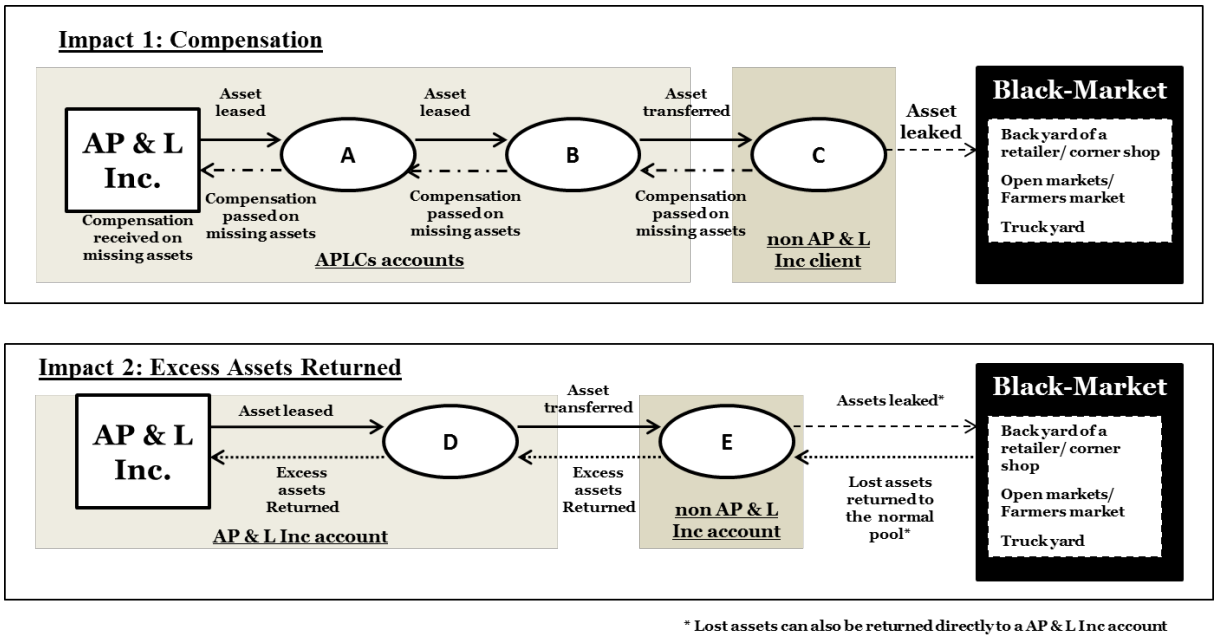

Figure 4. Impact of Black Market of Pooled Assets on AP&L Inc.

Lease pools, especially those that feature unidirectional flow of pooled assets depict complexity because (i) assets remain in the pool for an indefinite period of time making it difficult for AP&L Inc. to monitor their movements (ii) assets move between several clients and locations making it hard for AP&L Inc. to control the assets, specifically those that leak from the lease pools, and (iii) AP&L Inc. clients (network partners) have no ownership over assets and therefore do not make adequate efforts to secure, use or manage them appropriately. This puts extra burden on AP&L Inc. to aggressively track the assets and also ensure that the assets remain in their lease pools in order to maintain revenue continuity. Refer Quotes D.

> "Pallets can flow (within the leased pool) without coming back to us until it is broken or needs servicing or the retailer, manufacturer has no utility for it. Managing the assets (pallets) is a problem for the company."
>
> "Asset (pallet) pool gets complicated (when) assets (pallets) move from Coke to Woolworths to 7/11. We do not have any control over the assets (pallets)."
>
> "The challenge with every customer is that it is not their core product. They do not have to maintain, service, track, take care of it."

Quotes D

9 Challenges in Implementing Tracking Technologies

In response to the perennial problem of asset tracking to plugging leakages from lease pools into black markets and reduce subsequent revenue losses, AP&L Inc. explored several IT initiatives. Historically, asset tracking is done generally through manual paper-based mechanisms. Clients compile asset stocks and reports manually and fax or send them by surface mail to AP&L Inc. This apparently causes delays as well as discrepancies in information flows due to the length of time taken, inaccurate compilation of data, misplaced reports and reporting errors. In order to address those issues, AP&L Inc. trialed various types of technologies such as Universal Product Codes (UPC) barcodes and Radio Frequency Identification (RFID) tags for facilitating asset identification and movements. However, such IT initiatives have yielded mixed results, as the mentioned technologies have proved rather

impracticable in certain types of leased assets such as plastic crates, containers and wooden pallets. As a result, tracking and preventing assets leaking into black markets has proved to be difficult. [Quote E: "*We can't eliminate the black market but only keep it in control*"].

Tracking capabilities is a strategic responsive action in managing pooled and leased assets than merely policing black markets. Some IT initiatives undertaken by AP&L Inc. for tracking their assets are discussed below. [Note: Information was also extracted from industry-based reports (e.g. http://www.ibisworld.com.au).]

Universal Product Codes (UPCs): Although UPC's are successfully used in the retail industry (since its introduction in the 1970's) barcodes are found to be unfeasible in identifying and tracking pooled assets. For example, barcode scanning usually requires a person to hold the item in front of a barcode scanner or point a scanner directly at the barcode in a proper reading angle within a fairly short distance (max 2 feet). Besides, the scanning can be done only one item at a time. For AP&L Inc., barcode scanning thousands of assets on a daily basis was difficult because (i) assets were mostly stacked beyond the readable distances of scanners or were hidden behind other assets such as pallets used for storing, hauling or transporting them (ii) scanning required more human resources to scan each asset at many different locations, and (iii) the amount of time spent in scanning meant longer lead-times for asset flows and reporting.

Radio Frequency Identification (RFID) tags: RFIDs resolved some drawbacks of UPCs. For example, RFID tags could be read from up to 10 feet away without being in the line of sight. It was also possible to perform multiple tag readings with a single scan by simply walking or driving along the assets with a tag reader. However, RFIDs had several drawbacks: (i) proper readings were not possible when water or metal blocked radio waves (ii) attaching tags to certain assets (e.g. wooden pallets) was not practically feasible as glue could not properly fix the tag to the asset surfaces while placing tags inside wood or metal-based assets was not practical as it masked and interfered with radio frequency signals. A realistic solution was affixing two tags to an asset but that was deemed expensive, as clients required spending up to $10,000 per reader portal (unit required for RFID scanning) and other RFID related infrastructure development. Although RFID had the potential to provide benefits, AP&L Inc.'s clients were not willing to share financial costs. They saw no visible and immediate tangible benefits [Quote F: "*They (clients in the supply-chain) don't have the kind of maturity to absorb technology without incurring costs*"].

Ubiquitous Technologies: AP&L Inc. is experimenting with new dynamic technologies such as mobile apps and social media to manage pooled assets in order to prevent it from leaking into black markets. However, there is scepticism on whether such technologies can improve asset tracking and reduce leakages into black markets. AP&L Inc. is presently trialling mobile apps but is unsure whether that will yield expected outcomes for tracking assets in real time and stop assets from leaking into black markets. [Quote G: "*Mobile apps do not track anything. But it can help in timely reporting (and) improve the accuracy in reporting so that when there is an issue, you can zero down on the page where there is a leakage*"].

Besides, how much a firm can reduce its revenue losses by implementing mobile apps remains uncertain. [Quote H: "*We still haven't got concrete numbers to say that (the threat of) black market has reduced*"].

10 Conclusions

The context of our study (i.e. asset pooling and leasing service) investigated a unique industry-specific threat viz. black market of pooled assets. In the process we extended the theoretical understanding of firm agility (Roberts & Grover, 2012) by focusing exclusively on (a) sensing and responding to threats (b) reducing revenue losses as a firm's performance indicator (c) the uniqueness of black markets as a potential threat, and (d) asset pooling and leasing as a novel context for framing how firms and network structures aided by IT can sense and respond to threats. Broadly, our investigations and insights suggest a theoretical mismatch between the

sensing and responding capabilities of firms towards the threat of black markets. While firms are highly aware and sensitive to the threat of black markets, their responsive actions are rather inadequate when dealing with such threats. Our findings evidence that firms struggle to respond to industry-specific threats due to the unsuitability of technologies in providing asset-tracking capabilities. Therefore, IT in the context of our study is found to be unsuitable in mediating the sense-response capabilities of the firm in addressing threats. This reflects the importance of responding to threats in dynamic and hypercompetitive environments and the necessity of more investigations for understanding the nomological networks surrounding sensing and responding to threats. This would include precise antecedents to (i) sensing capabilities such as information flows and the role of technology in tapping supply-chain network partners, and (ii) responding capabilities such as dexterous IT solutions, integrative structures, people and processes to counter threats.

Pooled assets comprising heavy equipment and machinery are excluded from the scope and extent of this study. Although these assets are prone to theft and damage, they are easily recognizable, as they have identifiable indictors (e.g. codes, serial numbers) embedded or attached to them. This makes them highly visible. They are verifiable and can be easily accounted in routine stock checks.

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