Improving the Last-Mile: Eliminating Package Theft through Delivery Codesign

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Jamison Stevens
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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor
Sean M. Ferguson, Department of Engineering and Society

Introduction

Since the late 1990s, the upward trend in e-commerce sales has brought increases in package theft (*E-Commerce Retail Sales as a Percent of Total Sales*, 2021; Risher et al., 2020). To reduce delivery costs and supply chain strain while also increasing convenience, retailers and delivery services have shifted to depend largely on unattended deliveries, leaving packages vulnerable to theft (Stickle et al., 2020). At a rate of 1.7 million packages stolen and missing daily, porch piracy remains a widespread and growing problem that has impacted up to 36% of Americans in 2019 (*Protect Against Porch Piracy*, n.d.; Stickle et al., 2020).

During the coronavirus pandemic, more consumers turned to package deliveries—away from brick-and-mortar retail—for convenience and social distancing health benefits ("COVID-19's Impact on Delivery Service Trends," 2020). Additionally, the CDC and OSHA recommendations to use contactless delivery during the coronavirus pandemic accelerated the transition toward unattended package deliveries ("COVID-19's Impact on Delivery Service Trends," 2020). These delivery trends corresponded with an increase in package thefts across the country and raised the percent of victims impacted to 64.1% (Archive & feed, 2021).

There have been several attempts to improve the package delivery process through innovation, including unattended package delivery, package boxes, surveillance cameras, and delivery photos (*Lessons in Fraud from the Frontlines of Last-Mile Delivery*, n.d.). However, these partial solutions only address the problems of some stakeholders since they are based mainly upon the corporate perception of package theft and do not incorporate other key stakeholders' input. As a result, many current products and services offset stakeholder

responsibility rather than facilitating communication between stakeholders to ensure a secure and efficient package delivery process. For instance, current delivery tracking methods shift the burden of package security onto the consumer, and porch monitoring allows consumers to prove theft to other stakeholders and receive compensation for their losses (*What to Do If You Have a Lost or Stolen Package*, 2021). These examples demonstrate the disconnect between consumers, delivery services, and third-party stakeholders in the last-mile delivery supply chain, which leaves packages vulnerable to theft.

Although package theft remains a complex problem due to the number of stakeholders with varying interest levels and the changing delivery landscape resulting from the coronavirus pandemic, delivery services and consumers can develop a mutually beneficial solution to address package theft and streamline last-mile delivery. By applying the framework of codesign, this research will investigate how stakeholders in the package delivery process—law enforcement, consumers, retailers, delivery services, and delivery drivers—can collaborate to develop last-mile delivery solutions that prevent package theft and increase supply chain integrity.

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Sociotechnical Background

The transition toward e-commerce retail has increased pressure on package delivery supply chains and opportunities for package theft (Commendatore, 2020). This research proposes a codesign methodology, where key stakeholders change the last few feet of the delivery process based upon collaboratively-designed package security devices and services (Edmunds et al., 2013).

Tallbear and Edmunds's work presents codesign as a way to "Engage an array of stakeholders … with different knowledge, skills, and experiences, as well as different resources, sources of power and prestige, and interests in the project" (Edmunds et al., 2013). By incorporating consumers as active participants in the design of sociotechnical systems, the codesign process aims to produce an optimal solution that includes the end user's needs.

However, this method contains potential issues. When applying a codesign methodology to the package delivery process, delivery services must understand the differing consumer frameworks, communication styles, and relationships with last-mile delivery parties. Additionally, these parties must recognize that it is "Easy to slip back into a public consultation process," which differs from the codesign process suggested and will lead to ineffective solutions (Edmunds et al., 2013). Developing an understanding of the parties involved is critical to harnessing the benefits and minimizing the downsides of the codesign process.

Codesign is not only a way to develop empathy between stakeholders and form a better solution, engaging stakeholders in a collaborative design process, but the methodology is also a valuable analytical tool. Dissecting package theft is necessary to figure out how to engage stakeholders in a codesign process. Viewing this problem from a codesign perspective helps to break down the topic of package theft into stakeholders, their subproblems, and their end-goals. This analytical process helps to uncover the failure points in the last-mile delivery process and what must be changed to create a better solution for this problem (Steen, 2013).

Package Theft Characterization

Upon acknowledging each party's motivating factors, the codesign process requires the characterization of porch piracy. Package theft is a significant issue in all parts of the country. This crime mainly occurs during the day and near a road, so packages are visible. These parcels are typically medium in size and include branding (Stickle et al., 2020). The key takeaway from the findings of Stickle and colleagues is that thieves target easy marks. The package theft process includes three phases: entry, execution, and exit. The most straightforward path to ensuring package security is introducing a new product or last-mile delivery process that disrupts the entry and execution phases. The key to this is concealing the package in a convenient, hidden location, reducing package branding, and incorporating monitoring and sound systems to deter the intruder (Stickle et al., 2020).

Stickle and colleagues' analysis of package theft video recordings posted to YouTube.com provides a fundamental understanding of package theft based on a series of 67 videos. The availability of this video evidence from doorstep surveillance cameras demonstrates existing buy-in from consumers, which shows promise for recruiting these stakeholders into a codesign process.

While the video analysis by Stickle and his collaborators holds valuable information to characterize package theft, creating a solution to porch piracy requires a deeper understanding of package theft. This paper will analyze a variety of stakeholders to start this package theft problem inquiry and definition process. Each stakeholder group experiences the problem of package theft differently. When implementing a codesign process, it is necessary to incorporate personal, subjective experiences from stakeholders to develop a

better understanding of this problem. By better understanding each stakeholder's experiences and interests concerning package theft, the codesign process can produce a more effective solution to package theft (Steen, 2013).

Stakeholders

Law Enforcement

Developing a solution to package theft requires data, which can be sampled from stakeholder experiences or crime reports. Law enforcement agencies can compile data on these package thefts to hold thieves accountable and find areas that thieves tend to target. However, law enforcement currently allocates few resources to combatting package theft, evidenced by the lack of package theft crime data collected by law enforcement agencies nationwide (Stickle, n.d.). Additionally, even with video evidence, individual thieves are hard to catch, and this category of crime appears relatively harmless compared to other crimes (*How Amazon and the Cops Set Up an Elaborate Sting Operation That Accomplished Nothing*, n.d.). This may explain why 90% of package thieves are not caught (*Lessons in Fraud from the Frontlines of Last-Mile Delivery*, n.d.). While additional data would help characterize and address package theft, a lack of extensive package theft data indicates the low motivation that law enforcement agencies have toward solving this problem.

One potential reason that law enforcement might devote more resources toward investigating package theft is in the case of a package theft crime-ring or serial thief (Fink, 2022). Currently, there is no simple way for law enforcement to differentiate between a single offender and repeat offenders based on police reports, unless police receive video footage of the same person stealing packages or if there is evident suspicious activity at a

particular, concentrated location (Fink, 2022). Gathering such footage remains a challenge because receiving footage depends on consumers investing in porch surveillance devices and sending the footage to law enforcement agencies. Even so, law enforcement agencies do not possess a sufficient method to store and share these video recordings to identify package thieves. Some law enforcement agencies therefore utilize social media to recruit citizens' help, believing that community vigilance and improved communication channels are the best avenues to combat this problem (*Law Enforcement*, 7:29).

A potential avenue to recruit law enforcement into a codesign process would be to present the process as an effective method to design a mechanism to identify a theft ring or serial thief (*How Amazon and the Cops Set Up an Elaborate Sting Operation That Accomplished Nothing*, n.d.). Additionally, this solution could include a streamlined process for consumers to upload video evidence of package theft to a publicly-accessible database, which ties a location and time to the data. This remedy would likely help law enforcement agencies and community members collect, share, and analyze package theft data to prevent theft and catch thieves.

Residential Consumers

Residential consumers typically receive package deliveries to their residence or an off-site package box. These stakeholders occupy a wide variety of living arrangements across many locations, such as apartments, townhouses, or single-family homes in rural areas, suburban areas, and urban areas. Because most individuals have a limited budget, residential consumers seek a cost-effective, convenient method to ensure package security. Retailers and delivery services provide purchase protection guarantees on delivered items

to protect consumers' limited budgets. For example, Amazon's A-to-Z Guarantee places much of the financial burden of package theft on firms (*A-to-z Guarantee - Amazon Customer Service*, n.d.). However, package security proves paramount when ordering necessities, time-sensitive deliveries, and life-critical products. Due to the coronavirus pandemic, more residential consumers opt for delivered essentials, increasing the importance of package security (Archive & feed, 2021).

To combat package theft, companies have developed several product offerings that incorporate smart devices and other technological security innovations into their delivery methods, such as Amazon Key and near-field communication locks (*Lessons in Fraud from the Frontlines of Last-Mile Delivery*, n.d.). These Internet of Things (IoT) devices have led to an increasing number of parallels between residential package security and the field of cybersecurity. One takeaway from the connection between these two fields is that consumers face a trade-off between convenience and security (*The Tradeoff Between Convenience and Security – A Balancing Act for Consumers and Manufacturers | McAfee Blog*, n.d.). For a package delivery innovation—whether a device, process change, or both—the balance between convenience and security proves different for each residential consumer. For instance, off-site package boxes offer excellent protection, but there remains a convenience cost that may prohibit consumers from using such delivery methods because of the increased cost of picking up their mail from a location different than their residence.

A collaborative design process would promote a package delivery solution that strikes a better balance between convenience and security by allowing many residential consumers to offer input in designing a solution that permits home delivery while also enhancing the

security of package deliveries. Additionally, the upward trend in deliveries of necessity items has led to an increased concern with package security among residential consumers, increasing the likelihood that these consumers would want to enroll in a codesign process (*Stop Stealing Our Packages! Porch Piracy Increasing During the COVID-19 Pandemic*, n.d.).

Business Consumers

Like residential consumers, business consumers do not want to deal with the loss of time and money accompanying package theft. Businesses can vary in both size and ownership structure, and supply chain characteristics may change a business's ability to respond to package theft. Larger companies tend to have more supplier contracts, office security, and cash reserves that provide such businesses with more robust capabilities to prevent and cope with package theft. Walmart's recent shift to more stringent supplier delivery standards demonstrates such ideas (Smith, n.d.). Additionally, businesses generally maintain a responsibility to remaining solvent and a goal of distributing profits to owners.

For small businesses, package theft experiences may appear more comparable to those of residential consumers, in which thieves target unattended packages after last-mile delivery. However, small companies likely maintain greater vigilance on their package deliveries because such businesses operate on a consistent schedule, which likely increases the security of deliveries to small businesses compared to residential households that might be vacant during the business day.

For large businesses, package theft tends to occur before the last-mile delivery happens and in the form of cargo theft. Since the coronavirus pandemic, cargo theft has dramatically increased due to the strain on delivery supply chains and the scarcity of semi-

trailer trucks for last-mile delivery (*Clogged U.S. Supply Chains Lead to Cargo Theft*, n.d.). When theft of a large business package occurs after last-mile delivery, such theft generally takes place at a warehouse and under a lapse in security, or where a company insider assists the thieves (*How to Minimize the Threat of Theft of Your Shipments*, 2020).

Advice for reducing package theft for business consumers suggests increasing delivery tracking after last-mile delivery occurs and improving communication channels with employees. Companies can accomplish this by keeping more thorough records of inventory and by enrolling employees in protecting inventory and reporting suspicious activity (*How to Minimize the Threat of Theft of Your Shipments*, 2020). These recommendations for increasing tracking and enrolling employees parallel the advice of law enforcement agencies for combatting residential package theft. In a codesign process, retailers (suppliers), delivery services, and business consumers can communicate their problems and needs to increase delivery tracking accuracy and communications, so that all these stakeholders and their employees can efficiently transfer deliveries and reduce package theft. By effectively demonstrating that a codesign process could create better methods to continue delivery tracking after the last-mile delivery process and improve communication channels during and after the last-mile delivery process therefore serves as an important avenue encourage business consumers to join a codesign process.

Retailers & Delivery Services

As a 2019 study by Dr. Yulia Vakulenko reveals, retailers and delivery services are effectively the same in the eyes of a consumer (Vakulenko et al., 2019). This is especially the

case for companies like Amazon that encompass retail and delivery. Because retailers and delivery services prioritize consumer relations, these two stakeholders have near-identical understandings of package theft and similar incentives to adopt a codesign methodology process to improve last-mile delivery.

As businesses, retailer and delivery services' primary institutional goals align with those of business consumers: remaining solvent, distributing profits to owners, and building a customer base. Seeing as they bear much of the financial burden for package theft, retailers and delivery services bear a strong incentive to eliminate such theft. By reducing the impact of package theft, retailers and delivery services maintain a greater ability to accomplish their primary goals.

Retailer and delivery services' reliance on unattended package delivery to reduce supply chain strain reflects a desire to maximize profits. These practices lower delivery costs by an estimated 50% and prove convenient for all parties if correctly executed. However, such methods do not offer much protection against package theft (McKay, 2021). Even with unattended package delivery, increasing supply chain strain due to the coronavirus pandemic challenges the current operations of these retailers and delivery services. For instance, adjusting to increased package deliveries necessitated that delivery services significantly expand their workforces, which could have led to lower hiring standards and decreased delivery driver oversight in the last-mile delivery process. Such trends may have served as a significant factor in increasing package theft, especially by delivery service employees (Stickle, n.d.).

A primary package theft problem that retailers and delivery services face is properly balancing between delivery efficiency and package security. Delivery efficiency is necessary to make sure that deliveries can get to the right place at the right time at a low cost—even with increasing supply chain strain. However, using unattended package deliveries to increase efficiency reduces package security, so retailers and delivery services must find a way to improve package security without prohibiting their efforts to improve delivery efficiency.

Retailers and delivery services currently use several methods to cope with package theft and increase their profits: selling delivery protection technologies like Amazon Key, providing guarantees on package deliveries like the Amazon A-to-Z Guarantee, and package branding (*Amazon.Com: Amazon Key | In-Garage Delivery*, n.d.; *A-to-z Guarantee - Amazon Customer Service*, n.d.). Selling security technologies allows retailers and delivery services to profit from consumer package theft concerns while simultaneously reducing the possibility of package theft. Delivery guarantees also promote consumer satisfaction in order to build up a base of returning customers.

In addition, retailers and delivery services use package branding as a relatively inexpensive marketing strategy and product differentiator. Although package branding is generally beneficial for retailers and delivery services as a means to generate third party advertising revenue, such branding increases package visibility, which increases the likelihood of package theft. As such, one method to reduce package theft may be to eliminate ineffective package branding. However, branding remains the least-likely determinant of package theft, and may not hold a significant impact on the likelihood of

package theft if removed from packages (Stickle et al., 2020). Codesign could explore such possibilities by offering an avenue to learn about the effectiveness of package branding from consumers.

Based upon retailer and delivery services' response to increasing supply chain strain and package theft, the best way to promote a package security codesign process to retailers and delivery services would be to stress the opportunity to create a more efficient and monetizable delivery process. If the benefit that codesign affords retailers and delivery services in preventing package theft outweigh the current costs of package theft and the potential implementation costs of the codesign process, then those retailers and delivery services will likely enroll in a codesign process.

Additionally, if consumers are interested in a more accurate delivery tracking system or more accessible attended deliveries, retailers and delivery services could attach this information to shipping charges or a membership service like Amazon Prime (*Amazon.Com: Amazon Prime*, n.d.). This would allow retailers and delivery services to engage in second-degree price discrimination, or menu pricing, which can provide desired services to underserved consumer groups, allowing retailers and delivery services to expand their revenue streams. In the case of package deliveries and theft, underserved consumer groups include those who demand a more secure package delivery process. Additionally, retailers and delivery services could integrate a collaboratively-designed security product innovation into the last-mile delivery process. This is another potential option that could put security-minded consumers at ease, while also increasing revenue for retailers and delivery services. These options could have multiple, positive impacts on retailer and delivery services' profits,

including: 1) raised profits through an increased ability to develop a consumer base (especially with a membership option) and more revenue streams, and 2) decreased costs through a lesser need to reimburse consumers for package theft.

Delivery Drivers

Delivery drivers are employees of delivery services tasked with delivering packages to consumers along their routes. Both employers and consumers expect delivery drivers to execute the delivery in the right place, at the right time, and in the most efficient manner possible to ensure package safety. With the increasing number of package deliveries and delivery labor shortages—especially during the coronavirus pandemic—delivery drivers must deliver more packages and work longer hours without reaping financial benefits, straining the relationships between delivery drivers and their delivery service employers. In 2021, California took legal action against Amazon and Green Messengers for this reason (Cal/OSHA, n.d.). Such issues have deteriorated the relationships between delivery services and delivery drivers, and this divide is a primary reason why some delivery drivers steal packages (*Lessons in Fraud from the Frontlines of Last-Mile Delivery*, n.d.). Unlike other delivery companies, UPS has seen success throughout the pandemic because their delivery workforce is unionized, which translates to high wages for delivery drivers, higher profits for UPS, and better labor relations (*Labor Shortage: UPS Union Drivers Give Delivery Service Edge Over FedEx (FDX) - Bloomberg*, n.d.).

Most delivery services utilize punitive measures against delivery drivers who do not meet satisfaction, promoting a distrusting, rather than supportive, relationship. In addition to this distrusting relationship, delivery services asked drivers to work additional hours in

unsafe working conditions (like high coronavirus exposure) while paying low wages. These factors may have increased the number of disgruntled employees, who are less likely to perform their jobs well and care about package theft (*Key Reasons for Job Dissatisfaction and Poor Employee Performance*, n.d.).

There are multiple options that delivery services could pursue to convince delivery drivers to work with a new last-mile delivery process. Such options include using codesign to minimize the time to complete their delivery routes and increase their compensation to match any increase in work that the new last-mile delivery process may bring. Most importantly, by bringing delivery drivers into the codesign process, the final design of the last-mile delivery service will incorporate the viewpoints of delivery drivers. Incorporating delivery drivers' input into the design process means delivery drivers would be more likely to accept these process innovations. Additionally, due to unionization in some delivery services, union representatives for these delivery drivers may need to be present for the codesign process and agree with any changes in the delivery driver job requirements.

Beyond including delivery drivers in the design process, delivery services could expand their workforce to keep delivery drivers' hours the same, or delivery services could pay delivery drivers greater wages. Based on the idea of efficiency wages, increasing pay may be a better solution for several reasons (*What Is Efficiency Wage Theory?*, n.d.). Since the coronavirus pandemic, hiring quality of delivery services has been questioned (Stickle, n.d.). By increasing wages, delivery services are more likely to attract higher quality talent for delivery driver jobs. Additionally, delivery drivers are more likely to work harder at their jobs,

work longer hours (especially if paid hourly), and accept the last-mile delivery process innovations.

Conclusion

While finding a solution to the problems of all stakeholders remains an incredibly complex challenge, applying the codesign process to last-mile delivery systems emerges as a viable approach to satisfying each stakeholder in the delivery process. As Figure 1 depicts, a vast array of issues may amplify package theft, making it difficult to determine the exact causes of this problem. However, each of these components are opportunities to begin addressing stakeholder problems collaboratively in a codesign process.

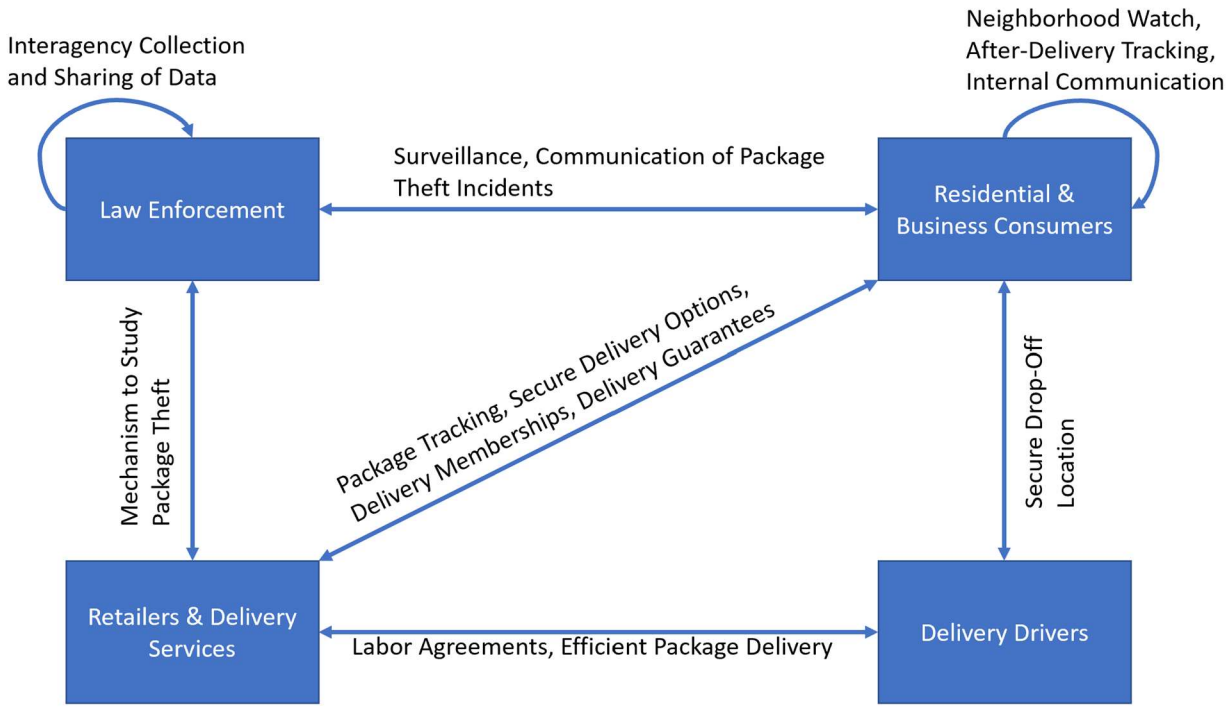

Figure 1. Graphical Depiction of Key Stakeholder's Points of Contention and Opportunities

Collaborative design emerges as a potential avenue for determining the root causes of package theft by balancing the wants and needs of the depicted stakeholders in an innovative last-mile delivery process.

A critical analysis of the problems facing each of the key stakeholders demonstrates that the parties involved will likely benefit from improvements to last-mile delivery, incentivizing them to participate in a codesign process. However, implementing such a process may not be as simple as simply asking for stakeholder involvement, as enrolling each of these stakeholders in a codesign process will require cross-coordination among every stakeholder to demonstrate shared goals and understandings of enrolling in a codesign process. A retailer or delivery service would likely serve as the initiating stakeholder in this process, as they have a profit-based motivation to join and can collect consumer-reported data on package thefts. To recruit further participation among other stakeholders, the retailer or delivery service will need to consider the barriers that might prevent other stakeholders from enrolling in a codesign process, such as work or family commitments taking priority over attending an extended codesign conference to address package theft. Because retailers and delivery services may benefit financially from a codesign process, they can invest resources to create these incentives for other stakeholders to participate, as long as the costs of providing such incentives remain lower than the expected net present value of the codesign process outcome.

Another consideration is how to select individual stakeholders to enroll in the codesign process. The easiest way is to group stakeholders based upon specific attributes of their community and select a random sample of stakeholders from each of these groups.

Example attributes to base groups on include: geographic location, socioeconomic status, order frequency and size, and the number of package theft experiences.

After selecting stakeholder groups and working to enroll these stakeholders into the codesign process, the implementer must determine how to effectively run a codesign conference. Such a conference should be held at a conveniently accessible and neutral location so that every stakeholder feels comfortable contributing. Next, there must be a way to accurately incorporate every stakeholder's genuine experiences and input, while minimizing conflicts with other stakeholders (Steen, 2013). A helpful addition may be a third-party mediator who helps mediate discussions between stakeholders to promote a fair, mutually agreed-upon outcome. After determining a potential solution, or solutions, the stakeholders at the codesign conference should first test out the solution(s) before implementing them into a real-life setting (Steen, 2013).

By breaking down the problem of package theft into the sub-problems and desires of stakeholders in the package theft process, the specific issues that contribute to package theft become more apparent. However, analyzing package theft with the codesign lens demonstrates that there is no single solution to address package theft. Therefore, stakeholders should implement a collaborative design process to address package theft. By combining the issues and experiences of all stakeholders into a package theft codesign process, each of the stakeholders can empathize with others and negotiate for a better solution that effectively maximizes each stakeholder's benefits.

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