WHITE PAPER

Last Time Buy or Last Resort? Insights from the Field

Audrey Bazerghi and Jan Albert Van Mieghem*
Kellogg School of Management
Northwestern University

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Executive Summary

Durable goods are characterized by their long life. End users typically expect extended spare part availability for maintenance and repair, sometimes decades after the original purchase. Consequently, manufacturers of heavy equipment, machinery or airplanes seek to provide spare parts as an after-sales service for as long as possible. Spare parts suppliers, however, struggle to strike a balance between supporting declining, legacy products and launching new, growing product lines. Last time buys are one of the most widespread resolutions to the conflicting objectives of suppliers and manufacturers for a durable product with legacy components.

A last time buy provides the final opportunity for Original Equipment Manufacturers (OEMs) to order a part before it is retired from the supplier's production line. Although last time buys are common and can allow OEMs to continue supporting old equipment with important user bases, they do not address the root problem of a mismatch between product and part life cycles.

This white paper reports our findings from a series of interviews conducted with practitioners in various industries where last time buys are common practice. We study the process that leads suppliers to resort to last time buys and discuss the issues caused by this practice. We uncover the main challenges in coordinating the life stages of part and product across agents in a supply chain.

While the high rate of change of technology can explain the prevalence of last time buys in certain industries like electronics, last time buys also arise in slower pace industries, due to a combination of challenges:

- Heightened demand uncertainty for spare parts hinders reliable forecasting of their sales volume and building business plans to sustain them;
- Substituting parts facing obsolescence is economically prohibitive for manufacturers due to the stringent technical requirements that typically result in them sole-sourcing these parts;
- Limited skilled workforce and production capacity require suppliers to choose carefully which legacy products to retire and which to continue to sell as spare parts, all while pushing forward with new product launches.

These challenges interact and put a strain on the supply chain. But as the pressure increases on supply chain partners, what alternatives to a last time buy do they have? We explore several avenues—investing in collaborative forecasting, adopting additive manufacturing, working with aftermarket parts providers or honing negotiation strategies—and sketch a path forward for all supply chain players.

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Contact e-mail: audrey.bazerghi@kellogg.northwestern.edu.

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1 Introduction

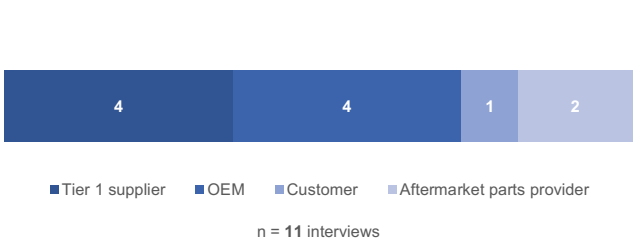
Changes in recent years have exacerbated the rate of retirement for hydraulic components with off-road applications. A wave of consolidation among firms drives a need for simplification and rationalization of product portfolios. Simultaneously, the electrification of families of products is bringing about the sunset of internal combustion engine hydraulics earlier than usual, in a move toward hybrid technologies. Similar trends are highlighted for automakers and industrial components companies in a recent McKinsey & Co article [1]. In this changing environment, the Tier 1 suppliers of Original Equipment Manufacturers (OEMs) have been rendering obsolete parts from previous end-product generations by sending more and more "last time buy" notifications.

A last time buy notification provides an opportunity for OEMs to place a final purchase order, before a part is retired from the supplier's manufacturing line. They are common in most durable goods industries: manufacturers of heavy-duty equipment for aerospace, military and off-road applications, as well as automotive manufacturers, all report having to manage last time buy notifications for spare parts. The consumer electronics manufacturers are also particularly vulnerable to last time buys due to the high rate of change in technology driven by their component suppliers [2]. Last time buys are widespread and have been studied ([3], [4], [5], [6], [7], [8], [9]). Although they can allow OEMs to continue supporting old products with important user bases, they do not address the root problem of a mismatch between end product and part life cycles.

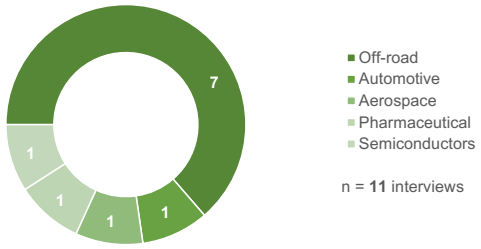
In this work, we identify the main challenges in coordinating the life stages of part and product across agents in a supply chain. Through a set of interviews with stakeholders from various industries, we study the process that leads suppliers to resort to last time buys, and discuss the difficulties linked to this practice. We propose a few solutions to address the key issues and sketch a path forward.

2 Approach

Findings presented in this paper are based on a series of stakeholder interviews. Participants were selected through recommendations from industry professionals. Their roles ranged from analysts to executives. They represented different tiers of the supply chain impacted by last time buys (see Fig. 1a) and worked in a variety of industries (see Fig. 1b). Interviews lasted from 30 and up to 60 minutes and followed a semi-structured protocol to guide the discussion. Questions were updated based on suggestions from precedent interviewees.



(a) Number of interviews by supply chain tier



(b) Number of interviews by industry

Figure 1: Interviews by category

Interviewees were asked to provide their perspective on five main topics: (i) the typical process followed for a last time buy, (ii) the reasons to choose a last time buy over other potential alternatives, (iii) the challenges in the process and (iv) how they address them today. Lastly, they were given an opportunity to talk about (v) what they would like to change. Recurring themes in their answers were picked out by analysing transcripts of the conversations and are discussed in the next section.

3 Results and Discussion

While last time buys help firms deal with the end of the life of a product, they also cause tensions between suppliers and manufacturers, and can impact end users that want to maintain or repair their equipment with obsolete parts. So we first explore the question: why are last time buys required?

3.1 Current situation

Over the course of its life, a durable good goes through different phases. We consider this durable good to be the end product of a supply chain with a supplier providing parts or components and a manufacturer assembling them into an end product, i.e., the durable good in question. For the purpose of this discussion, we define the following life cycle stages of the end product: product development, manufacturing & sales, and after-sales service (see Fig. 2). This aligns with how many durable goods manufacturers set up their organizations; a different business unit is responsible for first designing a product, then bringing it to the market, and finally servicing it once it exits mass production. The firm is responsible of determining when a product moves from one stage to the next.

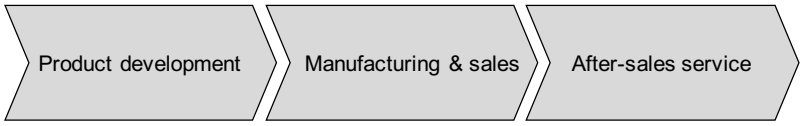


Figure 2: End-product life cycle stages

In particular, the manufacturing stage, characterized by mass production is appropriate for a good with a market that is growing or mature; typically, a plant is set up to produce the good in high volume/low variation quantities. But as sales decline and become more volatile, a firm must decide when to retire a good from production, potentially foregoing additional sales, in order to free up capacity on production lines for new growth products. The retired good is thereafter only supported through after-sales services.

These services are offered at a high markup to the original equipment manufacturer's customers. For example, parts required to do both preventive and corrective maintenance on equipment in the field are made available at a high price. Such after-sales services provide value to end customers by extending the life of an expensive product, and are big margin contributors for the original equipment manufacturer.

Last time buys occur when the life cycle stages of a supplier's part and the manufacturer's end product do not match. To see this, let us analyze the supply chain process leading to last time buys in more detail.

3.1.1 Process overview

At each stage of the end product's life cycle, the stakeholders in the supply chain work on different activities (see Fig. 3).

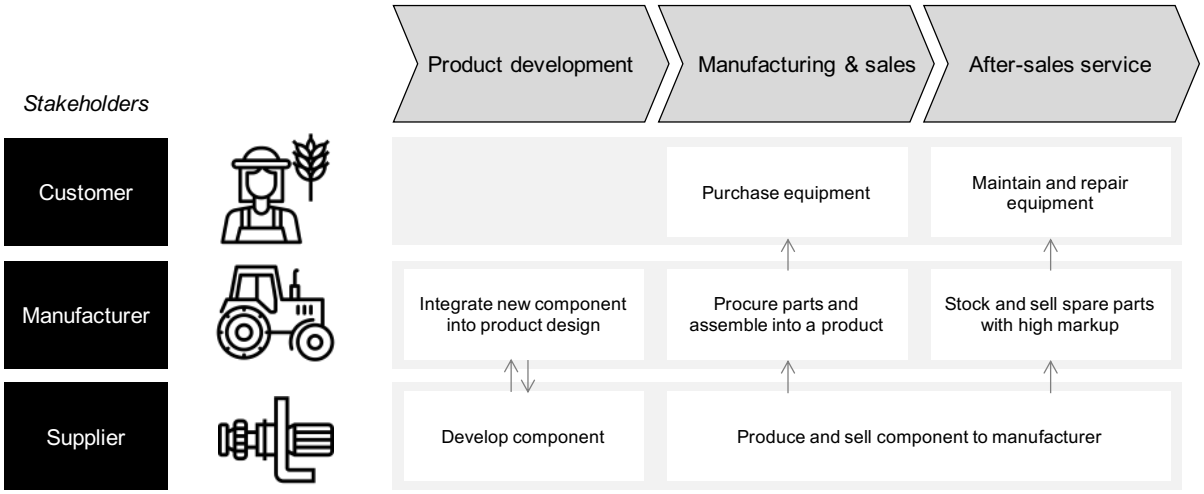


Figure 3: Typical activities by stakeholder at each stage of the product life cycle, illustrations by [10], [11], [12]

In order to fulfill its customer promise, the manufacturer continues to provide parts to maintain and repair equipment long after it has exited production. We heard reports of these long-term customer expectations from multiple suppliers during interviews.

"*A lot of customers and end users require spare parts for the next ten years at least. In some cases, [...] it can go up to 25 years.*" – Executive, supplier

"In one business, our product line was 50 years old. These products have a really long life. [...] We end up with a set of customers that have applications where the product has been installed for a long time, so there is a huge installed base." – Executive, supplier

However, the supplier often wants to exit production for the part, since the after-sales business is characterized by low volume/high variation demand which is difficult to sustain profitably on a process that was set up to support the manufacturing stage. This creates tension in the supply chain, as stakeholders try to align incentives to serve a gap in the process, marked in red on Fig. 4.

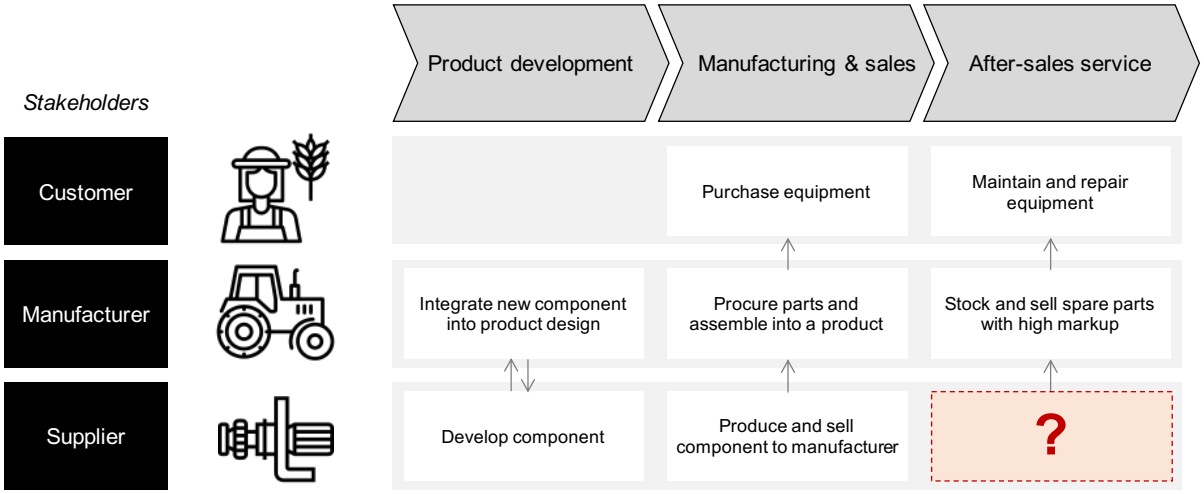


Figure 4: Gap in the process, illustrations by [10], [11], [12]

Last time buys are commonly used across multiple industries to fill in this gap.

3.2 Challenges

Suppliers resort to last time buys during the after-sales service stage for the manufacturer because of challenges characterized by market conditions, constraints on the OEM, constraints on the supplier, as well as the nature of their relationship. We take a closer look at some of the important challenges highlighted during interviews.

3.2.1 Market constraint: Fast pace of change of component technology

Last time buys are often caused by fast-changing technologies at the part level. That is particularly true for electronic components and related industries.

Examples

In one reported instance, the electronic controls and screens that were sold with a conveyor belt for a packaging line were already obsolete by the time the equipment was installed and the packaging line, operational. The manufacturer of the packaging line would most likely have received an end-of-life notification from the electronics supplier and might have been given an opportunity to buy screens in bulk in order to fulfill orders and repairs for customers.

In another case in the semiconductor industry, we were told:

"Since the technology moves so fast and new tool development is a 3 to 4 years process, we end up helping [our customer] with that. They just bought a 10-million-dollar tool, but the technology has moved on after two years, and they need something more to make the latest and greatest product." – Senior manager, supplier

But when technology evolves at a slower pace, as it is the case in the hydraulic industry, last time buys still arise due to other constraints.

3.2.2 Market constraint: Demand uncertainty

One of the intrinsic difficulties in producing a spare part to service the aftermarket is demand uncertainty. Both suppliers and manufacturers record sales in low volumes, that vary greatly from one period to another. This decline

in demand and increase in relative volatility is typical of the end-of-life stage. To forecast future sales accurately is thus particularly difficult.

Examples

Tier 1 suppliers face an important write-off risk as they get closer to the end of the life of a part because of demand uncertainty. These suppliers rarely interact with end users directly and have to base their demand forecasts on OEM orders. However, they then heavily rely on this proxy for the real demand to place orders with Tier 2 suppliers that impose large minimum order quantities (MOQs). If OEM orders do not materialize, the Tier 1 suppliers are left with large quantities of obsolete inventory to write off.

"Our suppliers have these minimum order quantities, but in our contracts with our final customer we don't have anything. So [in one such case] we had to buy 150 parts, we sold one and we had the remaining on our [books as] inventory." – Executive, supplier

Even manufacturers who are in constant contact with the end customers need to invest additional resources toward predicting demand for a component in end-of-life. An automotive manufacturer relies on a separate tool, i.e., a third-party software specializing in forecasts for spare parts at the end of their life cycle. It requires its own market data, models, processes and cross-functional teams to support decision-making.

"We have a long-term forecasting tool that utilizes part commodity life cycle curves. These life cycle curves are based on many years of demand history for parts that have completed their life cycle." – Manager, manufacturer

This uncertainty translated into a difficulty in forecasting sales can play against older components when they are evaluated for their potential to generate future, recurring revenues and can lead managers to obsolete parts prematurely.

3.2.3 Manufacturer constraints: High testing & validation costs and Customer expectation

Testing and validating an original component for a new product being developed is costly for manufacturers of heavy equipment: for example, think of validating a part for the assembly of an aircraft, with strict specifications and a heavy regulatory burden. The cost primarily originates from the technical difficulty, and thus the time involved, in the process of demonstrating a part satisfies all the requirements. Compounded by the customer expectation that product performance be highly consistent, the manufacturer is typically locked in with a sole supplier from the product development stage onward.

"Testing and validation costs are high, but single source relationships are more based on the fact that critical components have to match each other." – Senior manager, manufacturer

This also implies that once a supplier chooses to obsolete a component for a product in the later stages of its life, it cannot easily be replaced by an equivalent part to fulfill the after-sales demand. First, there is no equivalent part that had previously been validated in the product development stage. Second, there is limited accessibility to the end product in which the resourced part should fit. Suppose the machinery is in the field for off-road equipment, or installed on a production line for consumer electronics. In both instances, down time required for testing is very expensive. Third, even if the equipment is accessible, stakeholders told us repeatedly that it is hard to predict the fit of different replacement parts with the complex systems that the components fit into. Hence, finding a substitute for the component facing obsolescence might not be technically possible.

Example

A large Tier 1 supplier clearly explained why manufacturers are resistant to using equivalent components when the original one faces obsolescence.

"*Our products—and this is maybe going to sound a bit strange but—, there is an art to hydraulics. I've had this proven to me multiple times. You take part A and part B and test them in a lab, and they perform exactly the same. Then you put them on a hydraulic system, and they perform completely differently.*" The interviewee goes on to add: "*There might be 50 years of installed product in the field and still ongoing production for [our customer], and a concern that, no matter how much we can prove that the product functions exactly the same in the lab, when we put these complex hydraulic systems together, the bend of a hose or the difference in the fitting or a passageway can influence the performance of a multimillion-dollar piece of equipment.*" – Executive, supplier

Whether it is a similar part from a second supplier, or the recent model of the same part from the original supplier, they are rarely completely compatible with the older module of the equipment they are inserted into. But stakeholders have to find a solution that meets the exact specifications of the original product being considered for obsolescence, because stakes are high for the end users.

3.2.4 Supplier constraints: Limited resources and misaligned KPIs

When component technology changes fast, the part's life cycle is much shorter than the end-product's life cycle. In the hydraulics business, although part life cycles are longer, the constrained resources still bring suppliers to prioritize components in their portfolio. With limited skilled workforce and production capacity, suppliers choose wisely which legacy products to sunset in order to make room for newer, growth products.

Examples

For suppliers with limited resources and developing new products with growth potential, part of the problem is that it's hard to justify to investors supporting legacy products with declining sales.

"Global Tier 1 suppliers are constantly seeking to innovate with new products. When there is a legacy product, they have a difficult time maintaining interest [for it] inside of their product portfolio. Typically, the older product lines don't show year-over-year growth, and when this happens, [suppliers] become less interested in manufacturing them because they don't have enough resources to pursue product development, core growth and *older products."* – Executive, aftermarket parts provider (APP)

Reporting performance metrics about dwindling, legacy products that capture the value these add to the business is particularly difficult. One Tier 1 supplier tried to keep a legacy product in-house even as demand was shrinking, but management wasn't convinced it was a wise choice, seeing how poorly the product performed against the key performance indicators (KPIs) usually tracked.

"When we had one [legacy] product line in-house – we would fight about its KPIs all the time. When we looked at the inventory turns on that business, they were terrible." – Executive, supplier

Similarly, another supplier admitted that they do not single out in their report to management how they are coping with the end of the life of products. They review all products, regardless of life stage, with the same process.

"Honestly, we aren't tracking [how we're doing on phase-outs]. It's just a metric that we're not keeping. As you're reviewing the margins of the products during the yearly review process, management is looking at various things and would question something as it came up. I can't tell you that we have an actual report or something that is being tracked [for end of life]. That might be something that we aim for." – Director, supplier

3.2.5 Relationship constraint: Power imbalance

Although the manufacturer sources components from a single supplier due to the costs and technical difficulties involved in testing and validating another product, the large OEMs have historically held more negotiation power than the suppliers. They are strategic customers, and suppliers rarely push back on their requests to maintain production of a part and honor original pricing. The manufacturers are also privy to valuable information: they have better access to the users and they typically do not notify suppliers when they decide to move from one stage of the life cycle to the next.

Examples

In the automotive space, suppliers often have to sign master agreements that lock them into long-term production for parts (sometimes for up to 10 years) after the OEM has exited production. In the semiconductor industry, strategic customers can also hold a lot of power:

"The generic industry standard [for after-sales service] covers 5-7 years after we sell a product. But big contracts for tier 1 customers require much more end of life support. [...] The contracts with [one such customer] is very well written for them. We are required to provide alternative parts that we tested in our lab in case parts are obsoleted, for up to 5 years after we obsolete our product. Take Tool A as an example. We sold the first tool in 1999, I think we obsoleted it in 2017-2018, and we have to provide spare parts until 2023." – Senior manager, supplier

However, there are other supplier-manufacturer relationships in the electronic chips supply chains that would provide counterexamples to this; many large chip manufacturers hold all the cards, and customers can hardly push back on chips being obsoleted. There, the pace of technological change is incontestable.

In the off-road industry, although the power imbalance is not as pronounced as in the automotive space, suppliers have admitted to increasing prices for older products with other customers, but not with OEMs for whom preferential pricing was maintained.

"One of our biggest pain points is tied to the large OEMs and really getting them where they should be in terms of product life cycle and paying the right pricing for those products. It's just that they are so massive, and they have so much leverage, and the ability to push back on that kind of thing." – Director, supplier

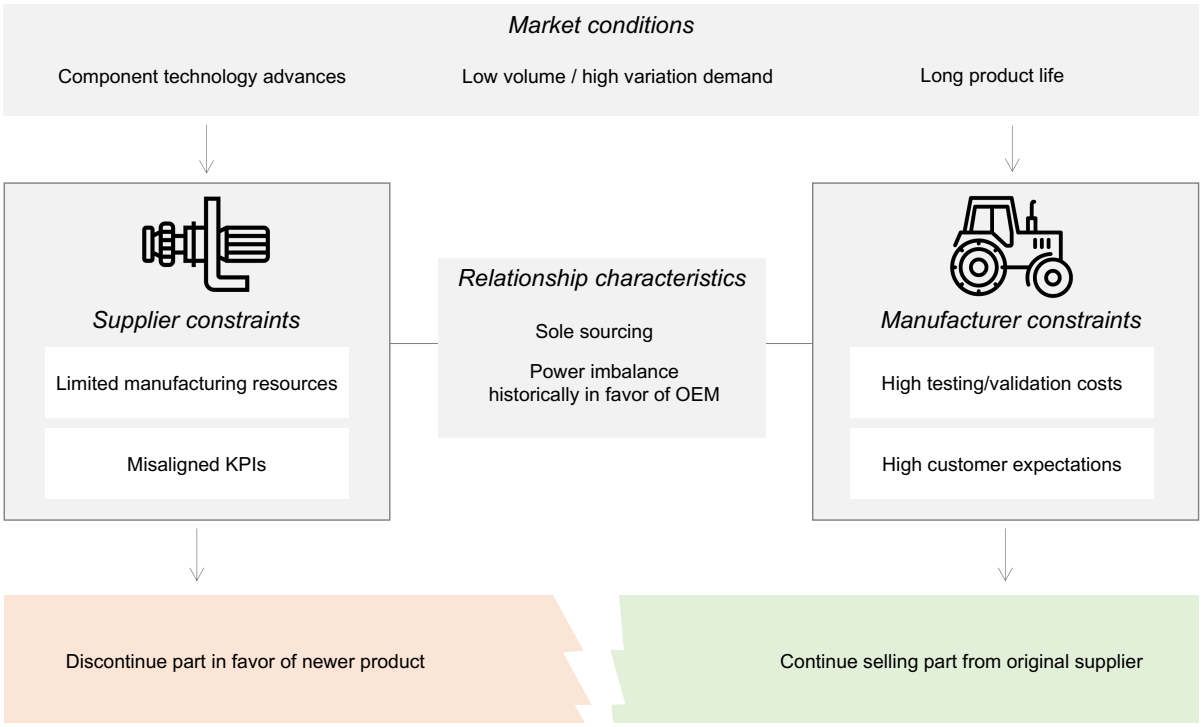


Figure 5: Challenges faced by suppliers and manufacturers lead to last time buys

3.2.6 Increasing pressure

All these challenges interact with each other, creating tension within the supply chain. We summarize the difficult situation in the infographic on Fig. 5.

Traditionally, OEMs benefited greatly from the power imbalance, and were able to convince suppliers to keep producing older generations of products to support customers in the field. But as alluded to previously, constraints are tightening for suppliers. First, a wave of consolidation among industry players temporarily drives up overhead costs and exacerbates product proliferation, thus putting pressure on limited manufacturing resources—in particular skilled workers. Simultaneously, the electrification of families of components is bringing about the sunset of internal combustion engine hydraulics earlier than usual, in a move toward new, hybrid technologies. As constraints continue to tighten for suppliers, they try to find ways to alleviate the issue. What alternatives do they have?

3.3 Result: Last time buys appear to be the only alternative

We argue that current players in the supply chain are practically left with no alternative to last time buys. When the supplier runs into profitability issues on an old part that the manufacturer would like to continue supporting for the aftermarket, they settle on a last time buy, time and time again. Why is that?

First, the manufacturer cannot resource the part, and the supplier cannot propose alternative products, without incurring high testing and validation costs (3.2.3).

Second, still today, many suppliers can hardly increase pricing with OEMs to improve the marginal economics of producing the old part, due to the power imbalance (3.2.5). A larger minimum ordering quantity (MOQ)—which provides economies of scale by spreading fixed costs, e.g., set-up costs and delivery costs, on a bigger sales quantity—is more often chosen as a compromise, but is also difficult to implement for the same reason. Furthermore, neither of these two options allows the supplier to withdraw the part from its portfolio, as shown on Fig. 6. This means they might help build a profitability case for the legacy component, but they do not free up resources in manufacturing that can be reassigned to growth products instead (3.2.4).

Consequently, the last time buy is often the supplier's only choice. However, it is still an imperfect solution for the manufacturer because of demand uncertainty (3.2.2). The OEM requests that the supplier produce one last batch of the part, and stocks up to cover the remainder of the after-sales demand for spares. Thus, a last time buy (i) ties up large amounts of cash and for long periods of time due to low demand, and (ii) can lead to either costly write-offs or customer dissatisfaction due to the high demand variability.

	Improves marginal production economics	*Provides economies of scale*	*Stops production and reassigns resources*	*Protects from demand downside*	*Captures demand upside*
Increase price	✓	✗	✗	✗	✓
Increase MOQ	✗	✓	✗	✓	✓
Offer last time buy	✗	✗	✓	✓	✗

Figure 6: Comparison of potential solutions to part profitability issues in end of life for the supplier

But all is not lost. We now turn to potential solutions that might alleviate some of the constraints that contribute to making last time buys the last resort.

3.4 Potential solutions

We propose innovative ways to tackle the challenges outlined in the previous section in order to reduce the need to resort to last time buys in the later stages of the life of a part.

3.4.1 Investing in forecasting tools

The uncertainty of demand in the aftermarket is intrinsic: it stems from the stochastic failure rates of the components, and is further exacerbated by competitive pressures—as more and more players aim to enter the aftermarket with low cost alternatives to OEM parts. We certainly don't want to argue that these issues can be fixed. However, it's important to highlight that statistical models that might be appropriate to forecast demand during the development and manufacturing stages of the life cycle might not perform well for forecasting the aftermarket demand. Forecasting "rare events," like failures of components that will require end users to purchase spare parts, differs substantially from forecasting high volume sales.

Hence, investing in specialized data sets and software that are tailored for the end of a part's life could improve operations planning and decrease the magnitude and occurrence of inventory write-offs, both for the supplier and the manufacturer.

A manufacturer shared their approach to forecasting for end-of-life decisions.

"Life-time requirement forecasts generated from the long-term forecasting tool are utilized to identify ways to sell the excess inventory. Any inventory greater than the life-time requirement is considered excess. [...] Ultimately, a decision may be made to scrap the excess. Another use of the long-term forecasts is to support long-term buy decisions. A forecast, along with the cost of a part and any setup costs that may be required, is used to determine whether to make a long or all time buy." – Manager, manufacturer

A supplier remains cautiously optimistic about the improvements afforded by artificial intelligence (AI) models.

"*Forecasting in our business is very difficult. We have used macro-external sources, we have AI models that we run. The AI models are more effective than I would have thought. But they are at a high level."* – Executive, supplier

Since both the manufacturer and the supplier would benefit from a more accurate forecast, there is an opportunity for the two players to tackle this problem in tandem with collaborative forecasting. This approach recommends real-time information sharing about demand between supply chain agents. With a higher quality and more reliable forecast, suppliers might be able to build and communicate business plans for legacy products more convincingly, prolonging the part life cycle. If a last time buy is still required in the end, manufacturers would have better information to size the order required for future demand.

3.4.2 Adopting additive manufacturing

As additive manufacturing continues to gain momentum, it can become a solution to bypass testing and validation costs. Manufacturers can equip themselves with 3D printers to produce parts ad hoc for the low, irregular after-sales service demand. They need to exactly mimic the original component through reverse engineering, thereafter producing at low cost for small quantities.

"We are looking at 3D printing as an alternative to long-term and all-time buys. We are currently looking at small plastic parts. It may even be metal parts in the future. 3D printing is something that is going to become more feasible and more affordable as the technology evolves. In the future, we would consider printing larger parts and printing them closer to the customer to save on transportation costs." – Manager, manufacturer

Although we've heard of this option being used in certain industries, it's still exclusively considered for plastic components. Powdered metal additive manufacturing for heavy equipment components has not been adopted.

3.4.3 Defining a business model for the aftermarket

Suppliers that would like to revisit their current processes to address the manufacturer's need with in-house resources have to define a new business model tailored to serving the aftermarket. This requires setting up separate processes for after-sales services, housed perhaps in a "plant within a plant", if not a separate division. These processes should be designed for low-volume/high-mix production and evaluated using key performance indicators (KPIs) different from the usual high-volume/low-mix metrics.

"Do we have internal discussions about an aftermarket division set-up? Yes. But so far, it would require a totally new set-up for the company: its own division that is really focused on that, and probably with a different kind of set of rules." – Executive, supplier

Indeed, firms looking to report sales growth or inventory turnovers for the end-of-life products are bound to abandon this endeavour. If instead they set up a write-off budget each year as a cost for the aftermarket business, they could report their compliance with hitting this provision or staying below it. Because the aftermarket is also centered around customer satisfaction, reporting service levels for customer orders instead of inventory turnovers could showcase the value provided by this unit of the business.

The new KPIs and new processes don't themselves solve the profitability or resource availability issues for the supplier. However, they could indirectly free up the high volume production lines for newer products, as the old products move on to an after-sales division with its own set of assets organized in a "job shop." They also lead to improved profitability, since the processes tailored to the low-volume/high-mix production can reduce opportunity costs from taking up precious time on high-volume/low-mix production lines. Lastly, they open up the door for a discussion about price increases with OEMs post-production, since a different division with a very different customer-profile, heavy on distributors, can lead that negotiation.

3.4.4 Partnering with an Aftermarket Part Provider (APP)

Another solution is available: when suppliers are considering discontinuing a product, they can decide to sell this portion of the business to a third party instead of building in-house capabilities as suggested in (3.4.3). The third party then provides original equipment aftermarket parts and differs from repair shops or providers of knockoffs. We will refer to this third party as an aftermarket parts provider (APP).

An APP is configured to run small batches of products with minimal fixed overhead. The fixed overhead allocation to product cost is often a problem for Tier 1 suppliers: with expansive corporate services, or high rent and utility bills for large plants, even a legacy product with an attractive unit contribution margin can look unprofitable once its per unit cost is presented under full absorption, with the burden of fixed overhead attributed to it. In contrast, an APP has few office staff members on payroll, favoring skilled workers, and co-locates many high margin products with low volume in a smaller but flexible manufacturing floor. Under the full absorption accounting principles, the legacy products are thus more attractive for an APP.

Such an APP can even take over the tooling and any other equipment required to produce the part, as well as buy the current inventory and the rights to the design from a Tier 1 supplier. They are then able to supply the OEM parts for the after-sales service that exactly match the original part (see Fig. 7). This option allows the OEM to continue to carry little inventory risk; however, it comes at a higher unit price. Given that OEMs do not hold the same negotiation power over APPs, these can re-price in a way that Tier 1's historically shied away from.

This solution can apply to parts that the supplier firm is willing to sell and that are attractive to a third party. Typically, these parts have low intellectual property (IP) risk, some remaining demand and tooling that is not yet worn out. In the off-road industry, suppliers often own the intellectual property for the part, so they are the ones selling the rights to the APP. In the aerospace industry, the manufacturer owns the intellectual property of many parts that are validated by regulatory entities. In that case, the manufacturer sells the rights of the product to a shop when the supplier decides to stop production.

"There are a lot of 'mom and pop' shops that have specific machine-shop capabilities. There is a willingness from those smaller shops to take on some work that no one else wants, because it's their way into the industry. In

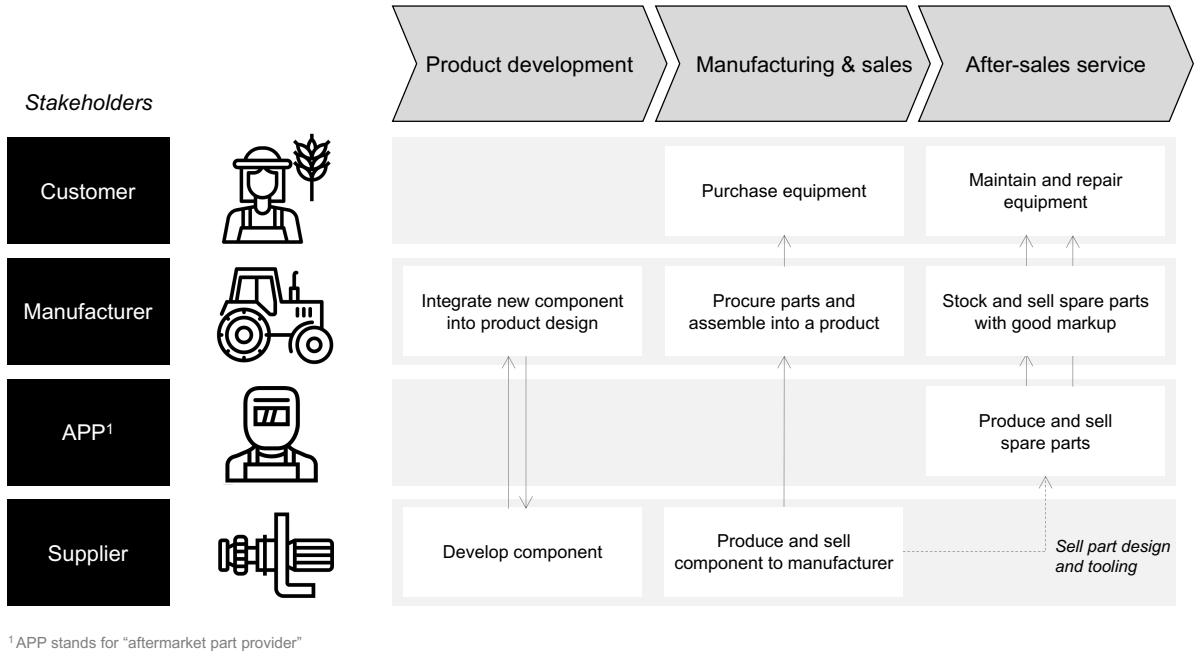


Figure 7: Process with sale of the part business to an aftermarket parts provider (APP), illustration by [13]

many cases, if the original producer of the part is not really interested—business is not there, profit is not there—, we often own the tooling, the drawing, the IP. So for some of these [smaller] shops, it's fairly low risk. Tooling is provided, so is the design, and if we aggregate enough, lumpy demand becomes interesting. A small shop with lower overhead can make a living out of it." – Executive, manufacturer

3.4.5 Approaching negotiations differently

While the focus of last time buy notifications is to kick off a discussion about the imminent obsolescence of a legacy product, suppliers and manufacturers tend to negotiate by taking a "product portfolio approach." That is, they leverage other products in the basket of business they conduct together in order to influence the outcome of the negotiation on the last time buy. In particular, we have heard in interviews that (i) manufacturer sometimes threaten to move away future business on new products if suppliers discontinue production of a legacy part, and (ii) suppliers have resorted to offering discounts on new products to lessen the blow of the retirement of the legacy product in the same family.

In an upcoming research paper, we adopt game theory to study how the old and new product interaction can be leveraged by supplier and manufacturer during a last time buy negotiation. We present insights that can guide practitioners to find ways to incentivize the delay of a premature last time buy or justify the retirement of a product as sales forecasts change.

4 Conclusion

Mismatches between product and part life cycles are common and bring suppliers to send last time buy notifications. The goal of this paper was to present the perspective of stakeholders from different tiers of the supply chain and across industries in order to understand the challenges leading to last time buys and discuss ways to tackle them. We have identified the main constraints that bind suppliers and manufacturers, and proposed potential solutions to address them. These could help reduce the occurrence of last time buys, thus ultimately contributing to higher customer service level and lower inventory risk across all players in the supply chain.

As the rate of change of technology continues to accelerate, last time buys will put increasingly more stress on supply chains. We believe it will become critical to find new, innovative ways to address mismatches between product and part life cycles.

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References

[1] D. Distel, E. Hannon, M. Krause, and A. Krieg, "Finding the sweet spot in product-portfolio management," *McKinsey & Company*, December 2020.

[2] R. Rebello and P. Ghosh, "Leveraging last time buy to optimize product lifecycle costs and manage obsolescence," *Tata Consultancy Services Ltd (TCS)*, 2016.

[3] L. Fortuin, "The all-time requirement of spare parts for service after sales – theoretical analysis and practical results," *International Journal of Operations and Production Management*, vol. 1, no. 1, pp. 59–70, 1980.

[4] R. H. Teunter and L. Fortuin, "End-of-life service: A case study," *European journal of operational research*, vol. 107, no. 1, pp. 19–34, 1998.

[5] K. D. Cattani and G. C. Souza, "Good buy? delaying end-of-life purchases," *European Journal of Operational Research*, vol. 146, no. 1, pp. 216–228, 2003.

[6] J. R. Bradley and H. H. Guerrero, "Lifetime buy decisions with multiple obsolete parts," *Production and Operations Management*, vol. 18, no. 1, pp. 114–126, 2009.

[7] H. Li, S. C. Graves, and D. B. Rosenfield, "Optimal planning quantities for product transition," *Production and Operations Management*, vol. 19, no. 2, pp. 142–155, 2010.

[8] M. Pourakbar, J. Frenk, and R. Dekker, "End-of-life inventory decisions for consumer electronics service parts," *Production and Operations Management*, vol. 21, no. 5, pp. 889–906, 2012.

[9] Y. Shen and S. P. Willems, "Modeling sourcing strategies to mitigate part obsolescence," *European Journal of Operational Research*, vol. 236, no. 2, pp. 522–533, 2014.

[10] the Noun Project, *Farmer by Template*.

[11] ——, *Tractor by Vectors Point*.

[12] ——, *Pump by Eucalyp*.

[13] ——, *Welder by lastspark*.

7301 W. Wilson Ave
Harwood Heights, IL 60706

Telephone (780) 887-5400
Email sales@qccorp.com