EXPEDITED LOGISTICS SERVICES:

Improving Semiconductor Supply Chain Efficiency

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Introduction

Visitors to the 2015 International Consumer Electronics Show found more than 3,600 exhibitors on hand to unveil their latest innovations at what has been called an "annual festival of consumer electronics and excess in Las Vegas." The more than 170,000 show attendees were not disappointed as manufacturers showcased products ranging from faster/"smarter" phones, tablets, and laptops to fully integrated kitchen appliance suites and self-driving cars. Or, as one observer noted: "We saw connected light bulbs, smart pet feeders, teddy bears with health sensors, self-watering flowerpots, smart toothbrushes, and many more."

What all of these items have in common is that they are powered by semiconductor technology. "Everything with an on/off switch" is how the Semiconductor Industry Association describes the prevalence of semiconductors in everyday living. On a global basis, semiconductor sales were $335.8 billion during 2014, which marked an almost 10 percent increase over the year prior.

But with this growth has come expectations for continual improvement—to find ways for consumer products to become even smaller, faster, and more reliable. Electronic device manufacturers operate in a highly competitive world of continually trying to "outdo the competition" and race the "next great thing" to market. This, in turn, puts pressure on chip manufacturers to reduce lead times and improve efficiency. As new devices are continually brought to market, chipmakers face the unwelcome reality that many of their products have very short life cycles.

This rapid pace of development coincides with a fundamental transformation that has taken place within the semiconductor industry. Analysis by Accenture found that as recently as 10 years ago, the global market for semiconductor manufacturers was relatively stable and predictable, with demand coming largely from the computer and industrial sectors. To meet that demand, semiconductor manufacturers were singularly focused on chip functionality, with speed to market taking a lesser role since new product launches would typically have a lifecycle of three to four years.

Today that has all changed. The computer and industrial sectors have been overtaken by consumer demand for "smart connected devices" including smartphones, tablets, and PCs. A typical device manufacturer will launch a new device—usually with a high degree of hype and media attention—at least

once a year. And given that the current lead time for semiconductor manufacturing and supply chain processing is 24 to 28 weeks, it's easy to see that turnaround time has become a serious pain point.

Add to this the increasingly global nature of semiconductor industry supply chains. As much as 50 percent of chip manufacturing has been outsourced to low-cost Asian countries, which means the added hurdle of transporting finished chips to the appropriate OEM manufacturing site. To accomplish this, a manufacturer will need to have in place a highly visible logistics strategy that can seamlessly move products from one part of the globe to another, with little margin for error.

Intel executive Jackie Sturm commented on how her company has adapted to these changes. In an interview with *Intel's Free Press*, she commented on how smartphones and tablets have transformed Intel's operations: "I think it reminds us that we had in the PC space a very stable, well-understood, well-defined set of customer/supplier/ODM relationships. Everybody knew what the role of the ODM was and they had built their own supply chains and were able to go build parts on very quick notice because they had the ongoing relationships."

"In these news businesses," she said, referring to smartphones and tablets, "it's a whole different set of components and supplies. We're trying to bring things in with new functionality at both low cost and high performance. And all of those things mean that you'll be in more of an unsettled environment."

As semiconductor manufacturers try to make sense of what has become their "new normal"—changing product specs, demand for shorter lead times, global sourcing, need for flawless execution—many managers are realizing the benefits of relying on an expedited logistics solution. In fact, semiconductor chips are among the top consumers of expedited services.

With an expedited solution, a manufacturer can be assured that shipments will arrive on time, regardless of where in the world delivery is required. Expedited shipments also enjoy high levels of customer service and attention to all details ranging from customs compliance to packaging to last-mile service.

The following discussion will offer a detailed overview of the challenges currently affecting semiconductor manufacturers, with suggestions for meeting those challenges with a highly efficient, cost-effective logistics solution.

An Industry in Transition

To understand how dramatically the semiconductor industry has changed, consider that as recently as 2005 semiconductor production was largely driven by computers and industrial-use products. Accenture describes a period in which "every aspect of semiconductor vendors' supply chains—from R&D and design, through manufacturing, to sales, fulfillment, and post-sales support—was geared to meeting the requirements of these segments."

That, of course, all changed with the emergence of consumer-use products—tablets, smartphones, laptops. Today, semiconductor development is driven by consumer expectations for convenience and innovation. One billion worldwide smartphone shipments during 2013 is evidence of the consumer-driven focus of the semiconductor industry.

According to Accenture, by the end of 2011, just a year after tablets were introduced, there were already 102 different models on the market. By the end of 2015, more than 300 tablets are expected to be on the market.

Gartner reports that 216 million tablets were sold worldwide during 2014, a figure that will increase to 259 million tablets during 2016.

WORLDWIDE DEVICE SHIPMENTS BY SEGMENT, 2014-2016 (Millions of Units)

DEVICE TYPE	2014	2015	2016
Traditional PCs (Desk-Based and Notebook)	279	259	248
Ultramobile Premium	39	62	85
PC Market Total	**318**	**321**	**333**
Tablets	216	233	259
Mobile Phones	1,838	1,906	1,969
Other Hybrids/Clamshells	6	9	11
Total	**2,378**	**2,470**	**2,572**

Source: Gartner (January 2015)

Mobile phones have also seen an impressive rate of growth. Accenture estimates that more than 1,000 smartphones are expected to be released by the end of 2015.

These data make clear that two relative newcomers have taken the market by storm and, in the process, have completely transformed the inner workings of the semiconductor industry.

But consumer devices are far from the only "new" products keeping manufacturers busy. A survey by KPMG found that 61 percent of semiconductor executives believe sensors will

provide the strongest sector growth opportunity during 2015. As the survey analysis notes, “sensors are a key to automotive technology applications, touch screens, wearables, and the Internet of Things.” Industry executives also listed the medical (66 percent) and networking/communication (62 percent) industries as having the year’s top potential for growth.

Before addressing the “what” and “how” taking place within the world of semiconductor chip manufacturing, it's useful to have an understanding of the "who," with regard to the industry's largest manufacturers and buyers.

According to Gartner, the world’s leading semiconductor vendors include Intel, Samsung Electronics, Qualcomm, and Micron Technology. Together, these top five account for more than 40 percent of total market share.

TOP 10 SEMICONDUCTOR VENDORS BY REVENUE, WORLDWIDE, 2014
(Millions of Dollars)

Rank 2013	Rank 2014	Vendor	Estimated Revenue 2014	Growth (%) 2013-2014	Market Share (%) 2014
1	1	Intel	50,840	4.6	15.0
2	2	Samsung Electronics	35,275	15.1	10.4
3	3	Qualcomm	19,194	11.5	5.6
5	4	Micron Technology	16,800	41.0	4.9
4	5	SK Hynix	15,915	26.1	4.7
6	6	Toshiba	11,589	2.8	3.4
7	7	Texas Instruments	11,539	9.0	3.4
8	8	Broadcom	8,360	2.0	2.5
9	9	STMicroelectronics	7,371	-8.8	2.2
10	10	Renesas Electronics	7,249	-9.1	2.1
		Others	**155,679**	**5.3**	**45.8**
		Total	**339,811**	**7.9**	**100**

Source: Gartner (December 2014)

And who are the top semiconductor chip customers? Gartner lists Samsung Electronics, Apple, and HP as the world's largest purchasers of semiconductors. Together, these three companies account for more than 20 percent of worldwide semiconductor consumption.

For both buyers and sellers, there is a shared interest in improving processes within the semiconductor industry so that (a) technology can keep pace with design needs; (b) manufacturing can keep pace with planned sales/marketing schedules; and (c) the industry as a whole can be more responsive to changing demands—i.e., emergence of tablets, technology-centric automobiles, and kitchen appliances.

Note: Some columns do not add to totals shown because of rounding.

Source: Gartner (January 2015)

PRELIMINARY RANKING OF TOP 10 COMPANIES BY SEMICONDUCTOR DESIGN TAM, WORLDWIDE, 2014 (Billions of Dollars)

RANKING 2013	RANKING 2014	COMPANY	2013	2014	GROWTH (%) 2013-2014	MARKET SHARE 2014
1	1	Samsung Electronics	30.6	32.1	5.1	9.4
2	2	Apple	23.5	25.8	9.8	7.6
3	3	HP	13.7	14.7	7.1	4.3
4	4	Lenovo	9.5	12.8	33.9	3.8
5	5	Dell	9.1	10.3	13.2	3.0
6	6	Sony	7.7	7.4	-2.8	2.2
9	7	Huawei	4.9	6.0	21.6	1.8
7	8	Cisco Systems	5.6	5.8	3.1	1.7
10	9	LG Electronics	4.7	5.5	15.9	1.6
8	10	Toshiba	5.5	5.3	-4.0	1.5
		Others	**200.2**	**214.2**	**7.0**	**63.0**
		Total	**315.0**	**339.9**	**7.9**	**100.0**

Understanding the Pain Points

Improving Speed to Market

While Apple seems to have adopted a strategy of one significant product launch each year, usually unveiling upgraded models of existing products, other manufacturers have much faster product cycles. Samsung, for example, released an industry-leading 52 unique smartphones during 2014, while Nokia released 20 and Motorola unveiled 10. Samsung has announced plans to scale back somewhat but will likely continue to pursue an aggressive rollout schedule.

Each successive device rollout seeks to have some unique "wow" factor that differentiates it from competitors and from prior models. Thus, devices tend to become increasingly complicated, with semiconductor manufacturers tasked with coming up with increasingly complex solutions in shorter time frames.

Accenture reports the typical semiconductor development cycle is roughly six months, which has become untenable in today's environment. "The inescapable conclusion is that current semiconductor supply chains are too slow," the report states. "A six-month development cycle for a new semiconductor risks becoming a serious critical-path constraint on a device whose entire delivery cycle is shorter than that time frame."

As semiconductor manufacturers confront the unwelcome possibility of becoming the weak link in the supply chain, they must also contend with the dramatically decreased life cycle of their products. In some cases, a semiconductor chip that takes months to develop can become obsolete with days of being brought to market.

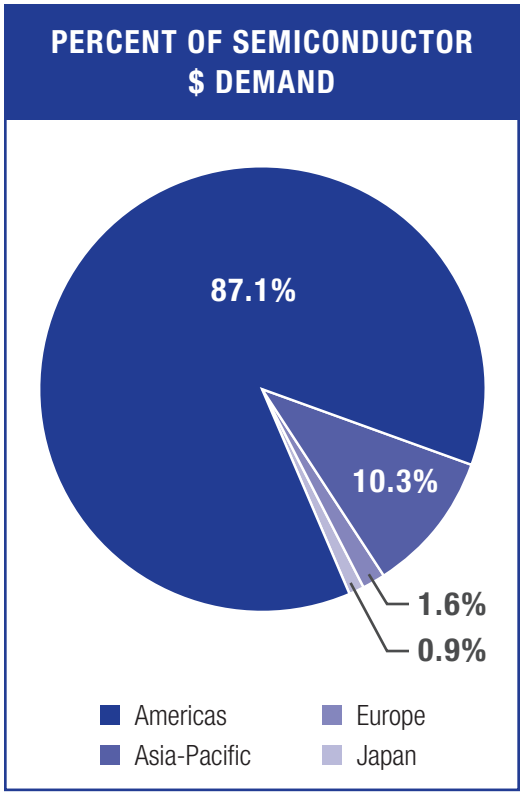
This short cycle means that manufacturers have to tread a fine line between being stuck holding too much of a soon-to-be obsolete product and not manufacturing enough to meet manufacturers' needs.

Multiple Industries Depend on Semiconductor Production

It wasn't that long ago that semiconductors were strictly the purview of mainframe computers and other industrial purposes. Today that has all changed, as evidenced by the tremendous worldwide growth of smartphones, tablets, PCs, laptops, and other consumer devices.

In fact, the presence of semiconductors touches all aspects of global production. Among the industries that now depend on semiconductors: aerospace, automotive, technology, health care, appliances, and the list goes on. Semiconductors have even made possible increasingly interactive toys, dolls, books, and educational materials—"everything with an on/off switch," according to the Semiconductor Industry Association.

This tremendous growth in industries served has forced manufacturers to assess their core processes. Supply chains that for years had been focused on meeting the demands of a single industry—technology—now must meet the diverse needs of multiple players.



Source: 2014 Semiconductor Industry Association Factbook

For many semiconductor manufacturers, this has been a serious pain point. Given that the cost of building a new semiconductor fabrication facility (known as a "fab") can exceed $5 billion, manufacturers face a range of choices from retooling existing facilities to absorb additional functionality to outsourcing production to lower-cost countries.

Improved Integration with Device OEMs

In many instances, slow semiconductor development is essentially "baked into the cake" because of lack of coordination—or visibility—between different parts of the process. Chip manufacturers often learn of device expectations relatively late in the planning process—too late to get a head start on chip development and too late to offer input about a proposed device design.

This inefficient process continues despite the negative consequences—missed deadlines, "11th hour" product redesigns, and less opportunity to vet potential design flaws during the development stage.

Increased Globalization

Semiconductor manufacturers are affected by the globalized market in two key ways: (1) products must be designed in a way that meets language, cultural, and regulatory issues associated with each country in which it is sold; and (2) managers face logistical obstacles associated with supply chains that can span several continents, multiple time zones, and dozens of languages.

Analysis by Zack's research notes that "big changes" have taken place within the semiconductor industry, with production increasingly transferred to low-cost operations. A key result of this has been the emergence of the Asian market where most production has shifted.

As the information on the following page from World Semiconductor Trade Statistics makes clear, Japan and the Asia Pacific region have a greater than 3:1 advantage over the next largest regional producer, which is the Americas.

Important to note though is that United States semiconductor manufacturers have found strong markets for their products around the world. According to the Semiconductor Industry Association, semiconductors are "America's #3 manufactured export over the last five years." Top export markets include the European Union, Mexico, Canada, China, Japan, and Brazil.

Moving product across the globe triggers an array of logistical challenges. Overcoming obstacles created by weather events, political turmoil, or poor infrastructure can severely hamper a scheduled delivery as can a poorly managed customs-compliance border process.

AUTUMN 2014—Q4 UPDATE

	Amounts in US$M				Year on Year Growth in %			
	2013	2014	2015	2016	2013	2014	2015	2016
Americas	61,496	69,324	79,725	82,298	13.1	12.7	15.0	3.2
Europe	34,883	37,459	36,700	37,877	5.2	7.4	-2.0	3.2
Japan	34,795	34,830	33,545	33,850	-15.2	0.1	-3.7	0.9
Asia Pacific	174,410	194,230	202,351	209,316	7.0	11.4	4.2	3.4
Total World—$M	305,584	335,843	352,321	363,342	4.8	9.9	4.9	3.1
Discrete Semiconductors	18,201	20,170	20,207	20,800	-4.9	10.8	0.2	2.9
Optoelectronics	27,571	29,868	32,493	33,613	5.3	8.3	8.8	3.4
Sensors	8,036	8,502	8,630	9,077	0.3	5.8	1.5	5.2
Integrated Circuits	251,776	277,302	290,991	299,852	5.7	10.1	4.9	3.0
Analog	40,117	44,365	48,019	49,781	2.1	10.6	8.2	3.7
Micro	58,688	62,072	62,547	63,617	-2.6	5.8	0.8	1.7
Logic	85,928	91,633	97,158	99,795	5.2	6.6	6.0	2.7
Memory	67,043	79,232	83,267	86,659	17.6	18.2	5.1	4.1
Total Products—$M	**305,584**	**335,843**	**352,321**	**363,342**	**4.8**	**9.9**	**4.9**	**3.1**

Adapting Your Semiconductor Supply Chain

Faced with so many competing challenges—speed, efficiency, and global customer and supplier bases—semiconductor manufacturers have recognized the urgent need to reassess current practices and adapt innovative, technology-driven supply chain solutions. For many businesses, a first choice was to enlist the services of an expedited logistics provider. A qualified expedited provider can assume complete responsibility for all logistics needs and "free up" managers to focus on other aspects of their business.

While, historically, the expedited category was used primarily for critical, extremely time-sensitive, or highly fragile shipments, a growing number of businesses are turning to expedited as a solution for "regular" shipping needs. Among the industries well suited for expedited services: semiconductors, automotive parts, pharmaceutical, and aerospace. In general, businesses find the efficiency and guaranteed service inherent to expedited services can largely offset the service's higher costs.

With regard to semiconductor manufacturers, efficiency and better management can be found in several important categories:

Speed to Market

The pace at which semiconductor-dependent products are coming to market has become so accelerated that chipmakers are under constant pressure to shave days—months—from their lead times. Manufacturers unable to keep pace are getting left behind. As Accenture notes, "…chip companies that can deliver on materially shorter lead times will command higher average selling prices than their potentially technically superior competitors because early market share capture of consumer devices is exceptionally valuable."

An expedited solution will address the need for improved speed to market in several ways:

- Streamlined solution in which all supply chain services are performed—or managed—by the same logistics provider.
- Personalized attention to detail through which logistics personnel will develop a customized solution to achieve specific manufacturing and distribution needs. Those same individuals will then manage the project, ensure all deadlines are met, and keep all key players informed.
- High degree of flexibility to adapt to changing market conditions and unanticipated challenges.
- Integration of technology and automation to improve visibility, thereby reducing risk of disruption.
- Full suite of transportation options ranging from "next flight out" to charter services to expedited ground solutions.

"…chip companies that can deliver on materially shorter lead times will command higher average selling prices than their potentially technically superior competitors because early market share capture of consumer devices is exceptionally valuable."

Source: Accenture, 2013

Globalization Issues

An expedited logistics provider will offer hassle-free service across international boundaries and seamless clearance through local customs processes. At a minimum, a qualified logistics provider will ensure that an expedited shipment arrives at a customs checkpoint with all paperwork ready to go and, where possible, already prefiled. All taxes/duties/fees will be paid in advance, and the shipment will be in compliance with all security and "other government department" mandates. A truly exceptional logistics provider will go beyond this and offer innovative services that include:

- Use of regional airports. Extremely busy airports can be avoided by rerouting a shipment to travel via a less-busy alternative.
- Maximal use of "customs-friendly" countries. Some countries are notoriously inefficient at clearing shipments through customs, while others can move shipments quickly. A savvy logistics provider will be able to plan a logistics route that avoids likely difficult customs procedures.
- Local couriers. A qualified provider will have local personnel on the ground ready to oversee the proper handling of a shipment. Local personnel will speak the local language and be fully aware of airport logistics, customs processes, and even local ground options. In some instances, the local agent will accompany the shipment to its final destination.

Inventory Management

Chip manufacturers face the unpleasant distinction of producing products with very short life cycles that lose value quickly. Having the capacity to accurately forecast demand is important but so is the ability to move existing inventory quickly to where it is needed.

With an expedited plan in place, an account manager has full visibility into global inventory levels and the capability to move products accordingly. Alternatively, a nonexpedited solution would house inventory in warehouses or distribution centers and potentially be located thousands of miles—continents—away from where it is needed.

Another critically important factor is the special handling semiconductor chip shipments require. Shipments must be highly secure and generally travel in containers equipped with tamper-proof locks. In addition, chips are highly fragile, so special care must be taken for gentle handling with a minimal amount of touches.

With an expedited plan in place, an account manager has full visibility into global inventory levels and the capability to move products accordingly.

Finding the Right Logistics Provider

A prevailing sense of urgency is a defining characteristic of the expedited industry in which lead times are measured in minutes and logistics providers seem to make the impossible happen on a daily basis. Not surprisingly, a diverse network of providers make up the expedited logistics industry, and it's important to weed through them to make sure you select a provider that best meets your unique needs.

For a semiconductor manufacturer, you will need a carrier with international expertise that can handle highly secure/fragile shipments and that can offer a high degree of flexibility. It's important to take the time to research a potential logistics provider well before its services are actually needed. You don't want to find out too late that your carrier overstated its capabilities or, for whatever other reason, is not capable of transporting your urgent shipments.

A few things to keep in mind when considering potential expedited carriers:

Customization and Collaboration

It's essential to view your expedited logistics provider as a partner. You want to build a relationship so there is mutual understanding of your business objectives, priorities, and needs. This information sharing can only happen through many, many direct conversations and ongoing open lines of communication. A good logistics provider will use this information to create a customized solution to meet your specific needs.

Personalization

As you build your relationship, it's important that the same individuals service your account the whole way through. The same individuals who prepare your original logistics solution should be the same people who oversee the pickup, transit, and final-mile delivery of your expedited shipments.

Depth of Assets

Integral to expedited service is the capacity to move a shipment, at a moment's notice, to anyplace in the world. Few providers have the deep network of assets necessary to accomplish this. A bona fide expedited service provider will be able to detail precisely how its network is configured and how it will respond to your request for service.

Experience

When it comes to managing expedited logistics, there is no substitute for experience. Choose a provider that has handled semiconductor logistics in the past—and can provide references. Unless a provider has been through the process, and knows firsthand what to expect, any claims of "guaranteed service" should be met with skepticism.

Customs Experience

Equally important is to choose a provider with strong experience in customs management. This is especially critical given the global nature of the semiconductor industry. An experienced customs manager will be fully knowledgeable about the customs requirements for every border your

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shipment will cross and will ensure that all your shipments are in full compliance. In some instances, an expedited provider can provide a qualified local courier to personally transport a shipment through the customs process and resolve any potential problems. An experienced provider can also plan an expedited logistics solution that bypasses busy airports with congested customs processes in favor of less-busy regional alternatives.

Technology

Tremendous advances in expedited logistics have been possible due to technological innovations. Logistics providers can provide high levels of visibility and shipment tracking, ensure constant communication between drivers/pilots and a central office, and have unprecedented access to route optimization and capacity availability. Many expedited logistics providers have their own customized technology solutions that allow a bird's-eye view into operations. Often these internal systems will integrate directly with a customer's own network, making it possible to generate reports, billing information, and shipping materials.

Value-Added Services

For many shippers, the benefits of expedited value are the premium levels of service that have become integral to the service, rather than the accelerated rates of delivery. Proof of delivery, tracking and tracing, and time-guaranteed delivery have become industry standards. Following are a few additional value-added services that some—but not all—logistics providers may offer:

Security

For a semiconductor manufacturer, this may be the most important factor of all. Added security is integral to the expedited process because of (a) fewer touches, (b) accelerated supply chains, and (c) extra personnel to monitor shipments. Certain shipments may be handled via a team-driver approach through which two drivers ensure that a shipment is never left unattended. Or a courier may be used to personally accompany a shipment traveling via air.

Customs Clearance

Shipments that cross an international border require compliance with all applicable customs, security, and revenue mandates. Customs agents are very unforgiving when it comes to filing proper documentation. It is essential, if your shipment requires a border crossing, to have a qualified customs broker or logistics partner who can ensure complete compliance and a hassle-free customs clearance process.

White Glove

Shipments that require special care often require super-premium white-glove treatment. White glove is a very specialized service within the expedited industry. White-glove freight requires drivers to have special training and to travel with specialized equipment, including furniture pads, pallet jacks, specialized tools, hand trucks, dollies, lift gates, and temperature-controlled units. Special security mechanisms usually are in place for white-glove shipments, and drivers need to be properly trained to perform any necessary assemblage or installation.

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Conclusion

In late 2014, a senior manager at Microchip caused a stir when he announced that an "industry correction" had begun, which would likely affect the industry for the next several months. Analysts at Citigroup quickly issued an explanation, noting: *"In semiconductor speak, an inventory correction occurs whenever demand drops off for a moderate period of time and can occur during economic expansion or contraction. Inventory corrections typically last 2-3 quarters with a step-down in demand and reduced visibility."*

In a perfect world, industry corrections would never happen because semiconductor manufacturers would have 100 percent visibility into their supply chains and inventory levels would be perfectly synced to demand.

It's not a perfect world, so manufacturers must instead turn to the tools at their disposal to help adapt to changes in the marketplace and to meet pressure for improved efficiency.

As many have found, expedited logistics services can be the most valuable tool of all, with its laser-like focus on detail, high levels of customer service, and on-time delivery guarantees.

Steady growth is forecast in the coming years for the semiconductor industry. With the right supply chain solution in place, a chip manufacturer can thrive and leave the logistics to its trusted partner.

Purolator. We deliver Canada.

Purolator is the best-kept secret among leading U.S. companies who need reliable, efficient, and cost-effective shipping to Canada. We deliver unsurpassed Canadian expertise because of our Canadian roots, U.S. reach, and exclusive focus on cross-border shipping.

Every day, Purolator delivers more than 1,000,000 packages. With the largest dedicated air fleet and ground network, including hybrid vehicles, and more guaranteed delivery points in Canada than anyone else, we are part of the fifth largest postal organization in the world.

But size alone doesn't make Purolator different. We also understand that the needs of no two customers are the same. We can design the right mix of proprietary services that will make your shipments to Canada hassle free at every point in the supply chain.

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