Centre for Productivity and Prosperity
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The performance of Québec aerospace firms in global supply chain management

Jacques Roy
Pierre-Marc Elias

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THE PERFORMANCE OF QUÉBEC AEROSPACE FIRMS IN GLOBAL SUPPLY CHAIN MANAGEMENT

Authors
Jacques Roy
Pierre-Marc Elias

Layout
Jérôme Boivin

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Centre for Productivity and Prosperity –
Walter J. Somers Foundation
HEC Montréal

3000 chemin de la Côte-Sainte-Catherine
Montréal, Quebec, Canada H3T 2A7
Telephone: 514 340-6449

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1. INTRODUCTION

1.1 CONTEXT AND OBJECTIVES

In 2016, Québec's aerospace sector generated sales of $ 14.4 billion and employed about 39,130 people, which represents approximately 50% of aerospace activities in Canada. It is a sector that is highly integrated to global supply chains, since more than 80% of Quebec production is exported.[1] It is therefore an industrial sector whose performance in international logistics is undoubtedly of great importance to ensure its success.

The objective of this research is to better understand the challenges and issues faced by Québec aerospace firms in terms of international logistics and to identify the best practices adopted by those recognized for their excellence in this field. To do this, we conducted a literature review that includes a few studies identifying a number of best practices for the following: 1) the total cost of ownership analysis in international trade and activities, 2) ensuring visibility on global supply chain activities, 3) ensuring compliance to governmental regulations, 4) the proper use of Incoterms, 5) the automation of import and export processes, 6) the minimization of international transportation costs and 7) the establishment of partnerships with other stakeholders such as freight forwarders, customs brokers and logistics service providers (3PLs).

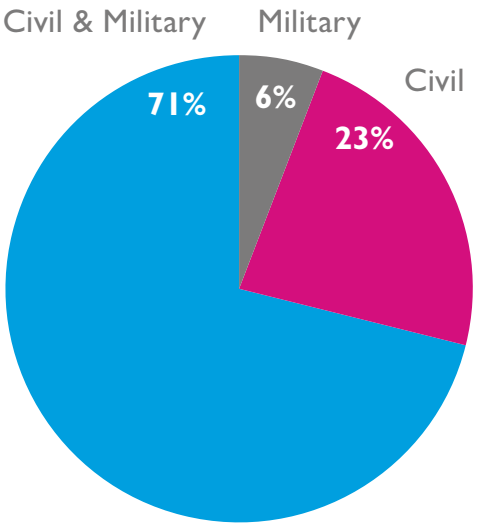
1.2 METHODOLOGY

The research method used consisted of conducting interviews with the logistics and supply chain managers of firms in the aerospace sector in Québec. In order to achieve this, we obtained the collaboration of Aéro Montréal, Québec's aerospace cluster association. This allowed us to obtain the contact information of multiple stakeholders in the sector. We targeted two business segments: 1) world-class and sizeable firms that allowed us to identify and document some of the best practices adopted in the industry and 2) medium-sized businesses to learn about their issues and performance levels in international logistics. Based on the literature review and following preliminary interviews with one of the leading firms in the sector, we developed an interview guide (see Appendix 2).

In total, 17 firms participated in our study. Interviews lasted more than two hours on average and were often followed by a tour of the facilities. The following figures provide a description of our various respondents.

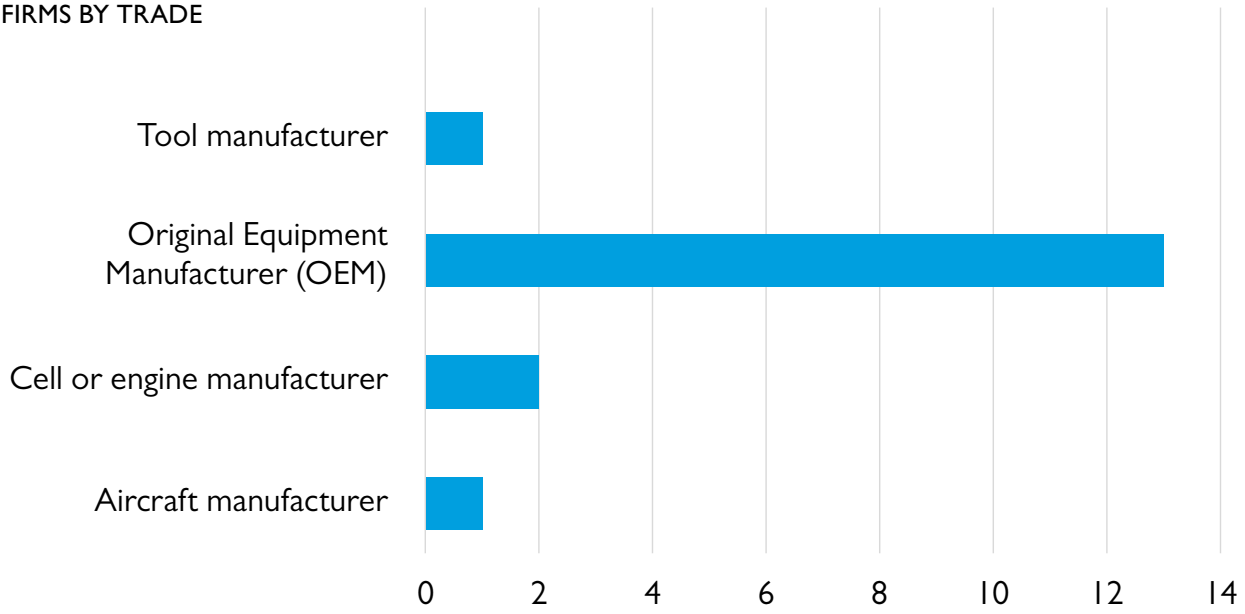
[1] https://www.economie.gouv.qc.ca/objectifs/informer/par-secteur-dactivite/aerospatiale/page/le-secteur10812/

FIGURE 1
FIRMS BY TYPE OF ACTIVITY



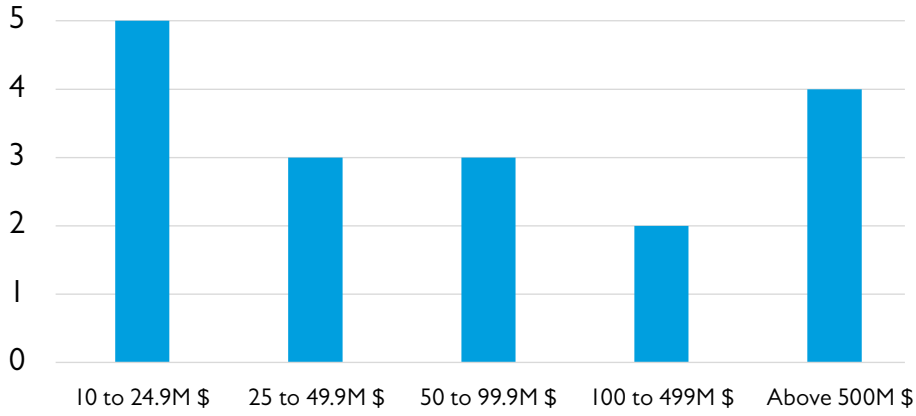
The majority (71%) of the participating firms are present in both the commercial and military sectors, while 23% are in the commercial sector only and only one firm (6%) focuses exclusively on the military sector. The vast majority (88%) of the participants work in the aerospace sector, while the others also operate in the space sector.

FIGURE 2
FIRMS BY TRADE



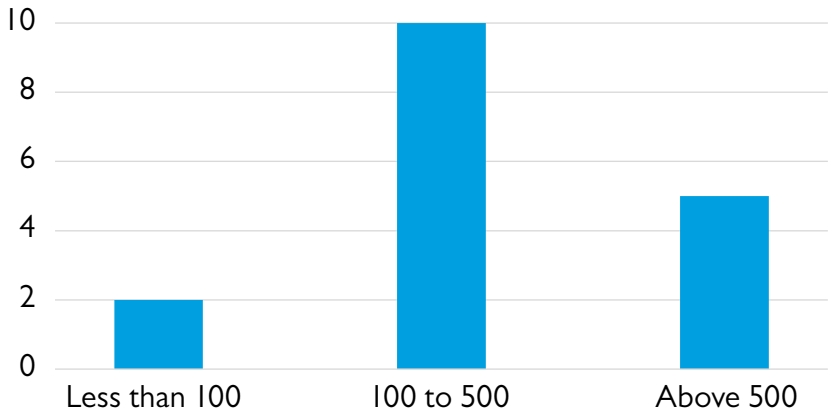
The majority (13 out of 17 respondents) consider themselves as original equipment manufacturers and two participants are cell or engine manufacturers. Finally, the two remaining are, respectively, a tool manufacturer and an aircraft manufacturer. The following figure shows a distribution of the respondents according to their turnover. There is a fairly good representation of small, medium and large companies.

FIGURE 3
FIRMS ACCORDING TO THEIR TURNOVER (CAD)



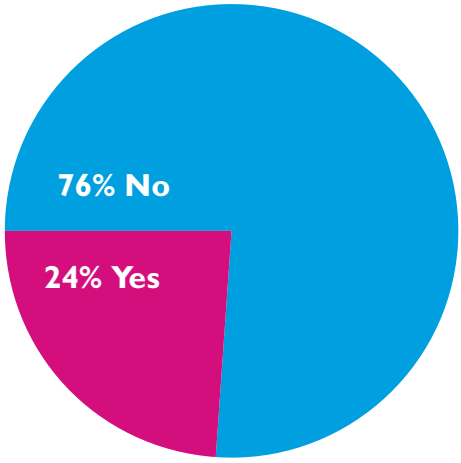
The following figure shows the number of employees from participating firms. There is a strong representation of firms with 100 to 500 employees. It should be noted that we were looking to interview medium and large players in order to identify firms that had successfully implemented best practices in international logistics. Finally, 4 out of the 17 interviewed firms were subsidiaries of multinational enterprises.

FIGURE 4
FIRMS ACCORDING TO THEIR NUMBER OF EMPLOYEES



The findings of this research allowed us to identify the strengths and weaknesses of the industry in international logistics and to propose solutions in order to help firms adopt best practices in this area.

FIGURE 5
IS THE FIRM A SUBSIDIARY OF A MULTINATIONAL ENTERPRISE?



2. LITERATURE REVIEW

Our literature review allowed us to identify some of the best practices regarding the following activities: 1) the total cost of ownership analysis in international trade, 2) ensuring visibility on global supply chain activities, 3) ensuring compliance to governmental regulations, 4) the proper use of Incoterms, 5) the automation of import and export processes, 6) the minimization of international transportation costs and 7) the establishment of partnerships with other stakeholders such as freight forwarders, customs brokers and logistics service providers (3PLs).

2.1 THE TOTAL COST OF OWNERSHIP IN INTERNATIONAL TRADE

Globalization of markets and increased competition at the international level are leading firms to focus more and more on the areas of expertise where they excel. Firms will then outsource to third parties activities that they do not master well or for which emerging countries have significant competitive advantages in terms of costs. This phenomenon has grown since the early 2000s as countries like China experienced very high and sustained growth rates. In fact, more than 90% of Canadian manufacturers sourced from China in 2007 (Industry Canada, 2007). Although this growth has declined in recent years, the fact remains that outsourcing in lower-cost countries is still a reality, despite the efforts of some governments to repatriate these activities inland. But offshoring of production activities is also benefiting other Asian countries and growth is also occurring in emerging countries in Central and South America as well as in Eastern Europe and North Africa.

In Canada, this phenomenon certainly affects companies working in traditional fields such as clothing or furniture. However, the same trend is observed in high-technology sectors such as aerospace. Indeed, Pratt & Whitney has production operations in Poland and Bombardier Aerospace manufactures electrical harnesses and other components in Mexico and China.

The consequences of this globalization of supply sources are manifold. First of all, firms certainly benefit from lower production costs, but this to the detriment of increasingly high transportation costs and the obligation to maintain larger inventory levels locally. Indeed, this is necessary in order to ensure continuity of their operations during the supply period, which translates into higher warehousing and inventory holding costs. In some cases, it may be preferable to use faster means of transportation, such as aircrafts, rather than suffer time delays associated with ground transportation. However, this will again lead to increases in transportation costs. According to Industry Canada (2007), lead times for products from China would range from a minimum of one to three months to a maximum of three to six months.

There are also other consequences related to this phenomenon. Firms incur additional delays due to the phenomena of congestion observed in ports and capacity problems with foreign suppliers, victims of their popularity. Finally, there are also mistakes in the orders received and quality issues of the delivered products, this being due in many cases to communication problems. To circumvent these risks, it is often necessary to increase the level of locally held stocks or to establish and maintain alternative sources of supply, which increases the complexity and the costs of procurement operations.

According to Industry Canada (2007), just 43% of Canadian firms that chose to source from low-cost countries reported lowering the total delivered cost of their products as a result of this decision. To do this, these companies have adopted a number of best practices that are presented in Table 1.

TABLE 1
BEST PRACTICES BY FIRMS WHICH HAVE REDUCED THEIR TOTAL DELIVERED COST

PRACTICE	PERCENTAGE OF THE FIRMS THAT HAVE ADOPTED THESE BEST PRACTICES
Total logistical cost analysis	84 %
Allocation of dedicated human resources	79 %
Establishment of secondary supply sources	79 %
Use of air transport	76 %
Training of suppliers in low-cost countries	70 %
Increased safety stock	21 %

SOURCE : INDUSTRY CANADA (2007)

Foremost, successful firms are those who know and understand their costs. This may seem obvious, but many firms decide to source from low-cost countries on the basis of anticipated labor cost savings alone and overestimate the benefits of doing so. A good analysis of the total delivered cost can sometimes reveal surprises to firms that have underestimated the increase of transportation, customs, storage and quality assurance costs, to mention only these.

The allocation of dedicated resources for international procurement and the foreign assignment of company personnel in low-cost countries are ways to ensure the success of the operation notably by raising the level of training and awareness of international suppliers. Despite these measures, there will be unforeseen events and emergencies. In such cases, successful firms do not hesitate to use air transport and dual sources in less risky countries. These measures certainly entail additional costs, but avoid keeping inventory levels too high, which is an unpopular practice among successful firms. Nevertheless, it is interesting to note that building up additional inventory levels is a widespread practice among 85% of those who have seen their total cost increase after sourcing in low-cost countries.

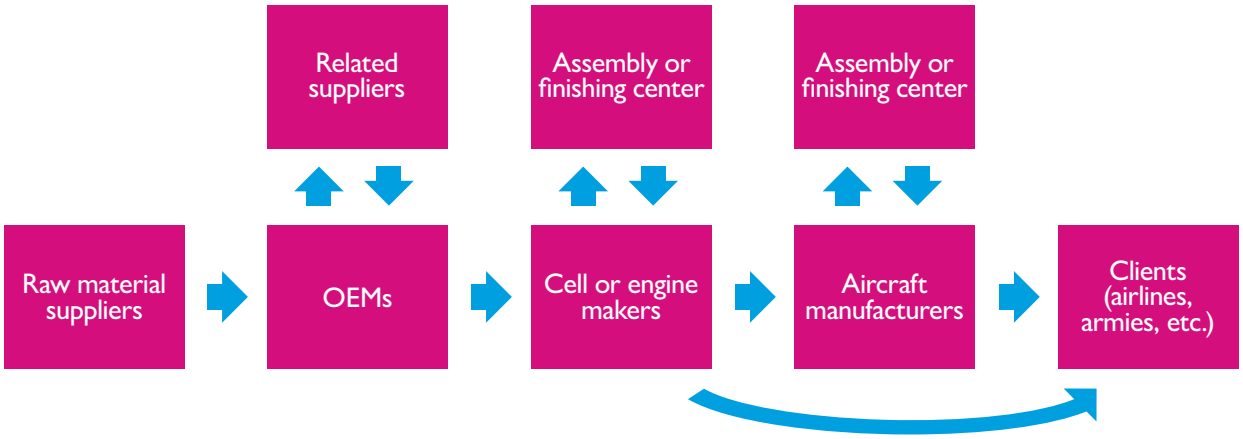
One of the key performance indicators that firms can use in this area measures the gap between the total expected cost and the actual total cost. According to a recent publication by Supply Chain Digest (2016), the best firms have spreads of less than 1% while the worst companies report differences ranging from 4% to 7%. These are firms that have taken appropriate means to measure their total cost performance. However, we can deduce that this is probably far from being the case for the majority of firms.

2.2 ENSURING VISIBILITY ON SUPPLY CHAIN ACTIVITIES

Where is the material? When will it arrive? Is this what was planned? Are questions usually asked by firms waiting for their inputs needed for to manufacture of their products. It is now essential for businesses to have their inputs at the right place, at the right time, in good condition and with the right amount. Business demand can sometimes be very dynamic and therefore the input can be desired earlier (pull), but also sometimes later if there is a delay in the production (push).

In aerospace, several aspects are to be considered. First of all, the flow of products and materials needed to make an aircraft undergoes a very winding course, as we can see in Figure 6. Each link in the supply chain may need to outsource some of the added value required for to the product. This can be the original equipment manufacturers or sub assembly manufacturers who send the parts they manufacture to related suppliers (e.g. for special processes). It may also include cell, engine or aircraft manufacturers who outsource part of the assembly. This practice is used in order to reduce costs or to allow the firm to subcontract activities that it cannot do itself. Consequently, it ends up lengthening lead times. In addition, this makes visibility on global supply chain activities a priority, since products and materials of high value are often found in the hands of external parties.

FIGURE 6
STANDARD FLOW OF PRODUCTS IN AEROSPACE



A great visibility level on a firm's global supply chain activities is therefore a key element in answering these questions and can help make real-time adjustments to an increasingly dynamic and volatile demand. The visibility tools are based on the identification of a calendar for all activities considered as movements with a certain acceptable degree of deviance toleration. If an activity is late or no information is received at the scheduled time, a notification alert is sent (by email or otherwise) to the concerned importer or freight forwarder.

Among the mechanisms used to ensure a better visibility level of supply chain activity, we find: the integration of the information with maritime carriers through EDI, the connection to the online portals of the logistic service providers, the update of the movements via the barcodes and possibly RFID when applicable. For example, by deploying real-time visibility mechanisms, the giant Cisco can manage a global supply chain totally outsourced with a small team of employees as if these activities were performed internally (Supply Chain Digest, 2016).

In an international purchasing context, firms wishing to improve the visibility level of their supply chains can provide online tools to their foreign suppliers that will allow them to 1) accept purchase orders, 2) provide production progress reports, 3) verify the quality of the purchased products, 4) provide labeling cartons and packaging with barcodes for tracking and compliance, 5) better track the movement of shipments and 6) generate ASNs (Advanced Shipping Notices).

More and more large firms are setting up virtual command centers to ensure the visibility of their supply chain and facilitate collaboration between the various players in the global supply chain (Véronneau and al., 2008).). On the other hand, volumes in the aerospace industry are often much lower than in other industries such as pharmaceutical or retail. Tools to improve the visibility on the global supply chain, to optimize transportation and dynamically capture demand are very costly and require considerable investments in resources and time. Lower volumes reduce the potential return on investment. The majority of our respondents, mostly SMEs with sales of less than $ 100 million, confirmed that they did not consider such an investment a priority for the firm, even though a good tracking system would facilitate just-in-time practices and inventory reductions.

2.3 ENSURING COMPLIANCE TO GOVERNMENTAL REGULATIONS

There are several regulations regarding trade compliance whether on customs, security (e.g. C-TPAT) or export control of certain items (e.g. Controlled Goods Program in Canada, International Traffic in Arms Regulations and Export Administration Regulation in the United States). Any firm involved in international transactions must comply with these regulations. If not, it may experience delays, retroactive contributions, interest, penalties or fines and even jail time.

At the Canadian customs level, the Customs Self-Assessment Program (CSA) is aimed at low risk importers, carriers and drivers who have been registered beforehand.[2] The CSA program simplifies several import-related customs procedures so that low-risk shipments can be processed more quickly and efficiently at the border, saving businesses time and money. The CSA program applies to eligible commercial goods that are shipped directly from the United States or Mexico. Some of the benefits to importers registered under the CSA include the ability "to use their own systems and procedures, which must meet the CBSA's requirements, to transmit commercial data, file a return and pay duties and taxes once a month from their financial institution. The self-assessment option represents significant savings because importers are no longer required to pay duties and taxes on each shipment".[3]

[2]https://www.cbsa-asfc.gc.ca/prog/csa-pad/menu-fra.htm

[3]Idem

Road transportation is by far the most used transportation mode for Canada-U.S. trade. However, in the aftermath of the 9/11 terrorist attacks, additional security measures deployed at the border have significantly increased the trip duration of trucks travelling through the United States. Since then, programs have been developed to improve the flow of trade at the border and reduce delays for road haulers and their goods. Among these programs is the Customs Trade Partnership Against Terrorism (C-TPAT), which allows companies that join it (shippers, carriers and consignees) on a voluntary basis to obtain certain benefits, such as less frequent inspections, shorter delays at the border and access to reserved lanes (FAST lanes). To do this, firms that want to obtain C-TPAT certification must comply with certain rules and requirements of the US Customs and Border Protection Agency. These rules include controls on facilities, the entry and exit of goods and personnel, background checks on employees, and so on. The Canadian equivalent of C-TPAT is PIP (Partners in Protection) administered by the Canadian Border Service Agency.

Still at the level of trade security, there is the Air Cargo Security (ACS) program, which is similar to C-TPAT but targets goods shipped by air. Any firm wishing to obtain this certification must comply with monitoring and inspection requirements established by Transport Canada.

The aerospace industry is also subject to non-tariff barriers imposed by governments. They want to control the export of certain products, technical data and software for military use and sometimes for commercial use as well. These barriers are raised with two objectives in mind: national security and the protection of national economic interests. In Canada, this is provided by the Export Controls Division of Global Affairs Canada.

Québec aerospace firms must take into account four important elements relating to export controls:

1) The *Export Control List* ("ECL")[4]

Canada controls the exportation of multiple goods and technologies through the ECL which divides in seven groups:

Group 1 : Dual-Use List

Group 2 : Munitions List

Group 3 : Nuclear Non-Proliferation list

Group 4 : Nuclear-Related Dual-Use List

Group 5 : Miscellaneous Goods and Technology

Group 6 : Missile Technology Control Regime List

Group 7 : Chemical and Biological Weapons Non-Proliferation List

[4]http://www.international.gc.ca/controls-controles/about-a_propos/expor/guide-2015_toc-tdm.aspx?lang=eng

It is probable that an aerospace firm possesses items belonging to one of the following categories of Group 1 (Dual-Use List) or Group 2 (Munitions List):

Group 1 – Category 1 : Special materials and related equipment

Group 1 – Category 2 : Materials processing

Group 1 – Category 3 : Electronics

Group 1 – Category 7 : Navigation and avionics

Group 1 – Category 9 : Aerospace and propulsion

Group 2 – 10 : "Aircraft", "lighter-than-air vehicles", "unmanned aerials vehicles" ("UAVs"), aero-engines and "aircraft" equipment, related equipment, and components, specially designed or modified for military use

Group 2 – 21 : "Software"

Group 2 – 22 : "Technology"

These export-restricted items may be in the form of physical goods (aircraft, part, tooling, raw material), technology (technical data such as drawings, 3D models, specifications, operating instructions, etc.) and software (source code).

2) The registration to the *Controlled Goods Program* ("CGP")

Quebec SMEs should strongly consider registering themselves to the CGP with the Controlled Goods Directorate. Indeed, this registration is legally required for the firm and each of its employees if it wishes to have access to items controlled under Group 2 (see above) and to items that may be controlled under the *International Traffic in Arms Regulation* ("ITAR") of the United States.

When an engine or aircraft manufacturer offers a military product controlled under Group 2 of the ECL, the majority of parts, software and technical data associated with this product are governed by the same export classification. A Canadian firm wishing to supply parts, tools or services related to these military programs of aircraft or engine manufacturers must be registered to the CGP.

Further information, including how to register to the program, is available on the Canadian government website.[5]

3) The necessity of export permits

If the company wishes to export an item controlled under the ECL, it will need to obtain an export permit issued by the Export Controls Division. However, it should be noted that an export permit is not necessary for exports made to the United States, with some exceptions. These permits are required for any type of item under the form of commodities, finished products, technical data or software. Therefore, if a firm wishes to do business with a customer, supplier or an international partner, it must consider the potential requirement of obtaining an export permit otherwise it could face heavy fines.

[5] https://www.tpsgc-pwgsc.gc.ca/pmc-cgp/index-eng.html

4) Considerations on the origin and destination of items

Finally, the Export Controls Division issues *Export Prohibitions* on certain countries resulting from economic sanctions and issues an *Area Control List* and a *Country Control List*. These measures restrict the nature of business that a firm may conduct with another business partner located in the country in question.

Therefore, if the firm wants to do business with a new customer, a new supplier or even if it wants to establish an international office, it must strongly consider this requirement. Several interviewed firms have expressed their openness to getting closer to the international sites of their customers, so this is certainly a current and relevant issue.

For more information, the Export Controls Division provides firms with an *Export Control Handbook*, available on its website[6]. This handbook specifies, among other things, how to apply for an export permit, provides a summary of export prohibitions and provides considerations on the origin and destination of items.

2.4 THE PROPER USE OF INCOTERMS[7]

Incoterms are used in international trade to establish the respective responsibilities of the seller and the buyer. Coming from the contraction of "International Commercial TERMS", Incoterms constitute a set of rules proposed by the International Chamber of Commerce (ICC) since 1936 with the latest version dating 2010. They form a codified language which precisely defines the rights and obligations of the buyer and the seller in the context of international exchanges. Finally, Incoterms will specify which party should assume a specific cost or risk depending on the step of transit of the merchandise. Incoterms answer three basic questions:

- Who bears the cost of transportation?
- When is the transfer of risk (loss or deterioration) made?
- Who is responsible for import and export customs formalities?

[6]http://www.international.gc.ca/controls-controles/assets/pdfs/documents/Export-Controls-Handbook-2017-eng.pdf

[7]Cette section est tirée en partie de Hien et al. (2006)

The table below shows the distribution of costs and risk for each of the 11 types of Incoterms 2010. As an example, for the Incoterm CPT, which is useful for all types of transport, the seller pays for the transportation costs from the start to the destination terminal (whether it is a port, an airport or a ferry or rail terminal). These costs therefore include packing, loading, customs procedures for export, pre-routing, terminal fees and main transport. On the other hand, the buyer must assume the risk starting at the main transport of the goods. In addition, the buyer pays for the transportation from the destination terminal to the final delivery point. The choice of an Incoterm is a mutual agreement resulting from a negotiation between the buyer and the seller that takes into account the ability of each to be responsible for transportation costs and risk.

TABLE 2

BREAKDOWN OF COSTS AND RISKS ACCORDING TO INCOTERMS 2010

Incoterms rules is an internationally recognized standard for international and domestic contracts for the sale of goods, published by the International Chamber of Commerce. This illustration shows risk and cost distribution between seller and buyer in accordance with Incoterms 2010.

	SELLER'S PLACE	LOADING AT SELLER	INITIAL TRANSPORT	EXPORT CUSTOMS CLEARANCE, DUTY PAID	RELOADING AT CARRIER'S TERMINAL	LOADING	CARGO INSURANCE	MAIN TRANSPORT	UNLOADING	RELOADING AT FREIGHT TERMINAL	IMPORT CUSTOMS CLEARANCE, DUTY & TAXES PAID	TRANSPORT TO DESTINATION	UNLOADING AT CONSIGNEE
EXW EX WORKS	RISK												
	COST												
	All types of transport (by road, sea, air, rail)												
FCA FREE CARRIER	RISK												
	COST												
	All types of transport (by road, sea, air, rail)												
FAS FREE ALONGSIDE SHIP	RISK												
	COST												
	Sea only												
FOB FREE ON BOARD	RISK												
	COST												
	Sea only												
CFR COST & FREIGHT	RISK												
	COST												
	Sea only												
CIF COST, INSURANCE & FREIGHT	RISK												
	COST												
	Sea only												
CPT CARRIAGE PAID TO	RISK												
	COST												
	All types of transport (by road, sea, air, rail)												
CIP CARRIAGE, INSURANCE PAID	RISK												
	COST												
	All types of transport (by road, sea, air, rail)												
DAT DELIVERED AT TERMINAL	RISK												
	COST												
	All types of transport (by road, sea, air, rail)												
DAP DELIVERED AT PLACE	RISK												
	COST												
	All types of transport (by road, sea, air, rail)												
DDP DELIVERED DUTY PAID	RISK												
	COST												
	All types of transport (by road, sea, air, rail)												

Source: Blue Water Shipping, https://www.bws.net/en/conditions/incoterms

There are relatively few scientific articles on the use of Incoterms. One of the few studies focuses on the use made by Québec exporters in 2006 (Hien & al., 2009). This study reveals that Québec exporters had limited knowledge of Incoterms as they tended to use always the same ones. However, the same study and the recommendations of the experts underline the importance of considering several environmental factors in the choice of an Incoterm. These factors include: international experience, value of the shipment, financial resources of the organization, customer bargaining power, risk and regulation of the destination country, and competitive landscape. It is therefore a strategic choice that can have a significant impact on the risks and costs of international transactions. This is particularly important for SMEs in a context of globalization. Indeed, all contracts involving a movement of material between a seller and a buyer should contain Incoterms because it is a public nomenclature, regulated by the World Trade Organization and known to all.

2.5 THE AUTOMATION OF IMPORT AND EXPORT PROCESSES

Managing international transportation is a much more complex activity than managing transportation within a country. The international movement of goods involves many stakeholders with whom the exporter or importer must transact: forwarding agent, customs broker, air or marine carriers, warehousing companies, etc. While a firm may delegate these tasks to a freight forwarder or integrator, this does not relieve it of its performance responsibility.

However, automation of the planning and execution processes of international logistics activities is not very advanced. In many cases, ERP systems that firms have adopted have not been designed to support business import and export processes. According to Supply Chain Digest (2016), only the best firms have managed to automate the processes of booking space, carriers and tariffs at the level of their international transactions in an integrated environment. The goal is to find all the necessary information in one touch.

2.6 THE MINIMIZATION OF INTERNATIONAL TRANSPORTATION COSTS

For the international transport of goods, firms tend to use the same routes often to get products from their origin to their destination. Indeed, once firms have established the route that seems the most efficient in terms of costs and level of service (speed and reliability), they tend to use it on a permanent basis. This practice may overlook opportunities to improve the performance of the global supply chain. For this reason, it is increasingly relevant to use dynamic routing to enable the business to adapt to changing market conditions, to change routing via crossdocking centers or to perform direct deliveries to stores. Also, dynamic routing may, depending on the circumstances, minimize the risk of delays due to unforeseen events, such as a strike at the Port of Vancouver or a hurricane. (Supply Chain Digest, 2016)

To perform dynamic routing, firms need tools such as transport management systems (TMS) capable of integrating international and domestic transport. They must also be able to collect real-time data on carriers (rates, capacity and contracts), movements (costs and status) and performance indicators.

2.7 THE ESTABLISHMENT OF PARTNERSHIPS WITH OTHER STAKEHOLDERS SUCH AS FREIGHT FORWARDERS, CUSTOMS BROKERS AND LOGISTICS SERVICE PROVIDERS (3PLS)

For several years now, subcontracting to logistics specialists commonly referred to as 3PLs (Third-Party Logistics) has become a way of doing business for a growing number of firms, both in the manufacturing and distribution sectors. To address the aforementioned challenges of globalization and increased competition from market liberalization, these firms have decided to focus on their core competencies which have led them to outsourcing part or all of the activities related to transportation and logistics. It is in this context that the notion of logistic partnership, which is a form of logistical outsourcing, has emerged. However, partnerships take a different approach because it goes beyond the simple decision to entrust certain activities to a third party who is a logistics specialist. As Bowersox pointed out as early as 1990 in an article on logistic alliances, partners work as part of an extended firm that acquires its own goals, rules and values. The alliance assumes a continuous relationship as opposed to the series of separate transactions occurring in a traditional subcontracting relationship (Roy and Bigras, 2000).

Lambert and al. (1996) propose a definition that highlights the main features of this business-to-business relationship approach:

> *"A partnership is a tailor-made business relationship built on mutual trust, openness, risk-sharing and profit-sharing with the objective of providing a competitive advantage resulting from improved performance over what the individual partners could have achieved on their own."*

In a partnership relationship, the objective is to obtain a competitive advantage resulting from a better business performance than what could have been achieved individually by the partners. Not surprisingly, the most successful companies are those that have established partnerships with their logistics service providers, freight forwarders and customs brokers. This is revealed in a recent Aberdeen Group survey, which reports that the best-in-class firms are the ones who work more closely with these partners (Ball, 2017). The survey also reveals that performing firms look for partners offering better value (reliability, flexibility and visibility) and not just the best cost (Aberdeen, 2006). In order to ensure the success of a partnership, experience shows that good contracts must be established with clear instructions and specific key performance indicators (KPIs) to properly manage this relationship.

3. CONDUCTED INTERVIEWS RESULTS

3.1 SUPPLY CHAIN PROFILE OF THE RESPONDENTS

Table 3 provides a portrait of the supply sources of the responding firms by region of origin and by transport mode used. We can see that firms are sourcing mostly in Québec and the United States. In Québec, the services of distributors are often used, especially for raw material. For supplies in North America, trucking is almost exclusively used, while air transportation is preferred for emergencies. For the less frequent cases where supplies sources come from overseas, air transport is mainly used because of the high value of aerospace products while maritime transport is also used in the cases of larger and less urgent goods.

TABLE 3
SUPPLY SOURCES OF THE FIRMS BY REGION OF ORIGIN AND BY TRANSPORTATION MODE USED

Firm #	1		2		3		4		5		6		7		8		9	
Region of origin	Spend (%)	Transport																
Québec	n/a	Road	40%	Road	60%	Road	n/a	Road	25%	Road	20%	Road	90%	Road	3%	Road	50%	Road
Rest of Canada	n/a	Road, air			5%	Road	n/a	Road							1%	Road		
United States	n/a	Road, air	40%	Road, air	30%	Road, air	n/a	Road	40%	Road, air	65%	Road	10%	Road	94%	Road	30%	Air, sea
Mexico	n/a	Road, air					n/a	Road	5%	Road, air							20%	Air
Europe	n/a	Air	10%	Air, sea	3%	Sea	n/a	Sea	25%	Air, sea	5%	Air			2%	Air, sea		
Middle East	n/a	Air			2%	Air	n/a	Sea										
Asia	n/a	Air	10%	Air, sea			n/a	Sea	5	Air, sea	0,1%	Sea						
Africa	n/a	Air					n/a	Sea										
South America	n/a	Air					n/a	Sea										
Firm #	**10**		**11**		**12**		**13**		**14**		**15**		**16**		**17**			
Québec	5%	Road	50%	Road	50%	Road	25%	Road	45%	Road	40%	Road			18%	Road		
Rest of Canada					25%	Road					10%	Road			2%	Road		
United States	90%	Road, air	50%	Road, air	25%	Road	50%	Road	45%	Road	50%	Road	50%	Road	78%	Road		
Mexico																		
Europe	5%	Sea					25%	Air	10%	Air			50%	Air	2%	Air		
Middle East																		
Asia																		
Africa																		
South America																		

Table 4 shows the sales destinations of the responding firms who agreed to answer this question as well as the modes of transport used by region of destination. We can see that the sales profile is widespread but that there is also a high proportion destined for Québec. This corresponds mainly to SMEs acting as suppliers of Québec big aerospace players such as Bombardier Aerospace and Pratt & Whitney Canada. These shipments are made by truck and in some cases it is the customer who picks up the goods from the supplier. Table 4 also tells us that a good percentage of sales (about 25%) is destined for the United States and that these shipments are made mostly by road and sometimes by air. Table 4 finally shows that some firms ship a large percentage of their sales to Europe, while others export to South America and Asia. In the case of these exports outside of North America, it is mainly air transport that is favored, while maritime transport is being used on an exceptional basis because once again of the value of aerospace products.

TABLE 4
SALES OF THE FIRMS BY REGION AND TRANSPORTATION MODE USED

Firm #	1		2		3		4		5	6		7		8		9
Region of origin	Spend (%)	Transport														
Québec	n/a	Road			32%	Road	n/a	Road	n/a	10%	Road	95%	Road	4%	Road	n/a
Rest of Canada	n/a	Road, air			24%	Road	n/a	Road	n/a			5%	Road	0-1%	Road	n/a
United States	n/a	Road, air	33%	n/a	32%	Road	n/a	Road	n/a	45%	Road			32%	Road	n/a
Mexico	n/a	Road, air					n/a	Road	n/a					0-1%	Air	n/a
Europe	n/a	Air	33%	n/a			n/a	Sea	n/a					29%	Air, sea	n/a
Middle East	n/a	Air			1%	Air	n/a	Sea	n/a							n/a
Asia	n/a	Air					n/a	Sea	n/a	45%	Air			35%	Air, sea	n/a
Africa	n/a	Air					n/a	Sea	n/a					0-1%	Air, sea	n/a
South America	n/a	Air	33%	n/a	11%	Road, sea	n/a	Sea	n/a							n/a

Firm #	10		11		12		13		14	15		16		17		
Québec	n/a				62%	Road	40%	Road	n/a					85%	Road	
Rest of Canada	n/a		90%	Road					n/a	47%	Road	10%	Air			
United States	n/a		3%	Road, air	24%	Road	20%	Road	n/a	41%	Road	20%	Air	13%	Road	
Mexico	n/a		4%	Road, air			5%	Air	n/a							
Europe	n/a				14%	Air, sea	20%	Air	n/a	12%	Air	70%	Air, sea	2%	Air	
Middle East	n/a						5%	Air	n/a							
Asia	n/a		3%	Air, sea			10%	Air	n/a							
Africa	n/a								n/a							
South America	n/a								n/a							

Respondents were asked to rate the supply chain performance of their business against three dimensions: the cost, the level of service offered and the flexibility of their supply chain activities. According to Table 5, firms estimate that their firm is in the industry average relative to their supply chain costs with an average score of 4.4 out of 7. As for their performance in terms of level of service, respondents consider it better with an average of 5.3 out of 7. The same is true for the flexibility, which is rated at 5.0 out of 7 for the average respondent. This being said, some respondents consider that their supply chain performance is significantly higher than the average of the firms in the sector (see # 1, # 12 and # 17), whereas the majority of other respondents consider themselves to be average. In general, respondents emphasized the importance of delivering quality products within the promised timeframe. In order to do so, it was more important for them to meet the production schedule than the logistical dimension of it.

TABLE 5
SUPPLY CHAIN PERFORMANCE APPRECIATION BY EACH FIRM

Firm #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Average
Supply chain performance - cost (scale of 1 to 7)	6	3	5	n.a.	5	6	3	5	4	5	4	5	4	5	3	4	4	**4,4**
Supply chain performance - level of service (scale of 1 to 7)	6	5	4	n.a.	5	6	3	4	6	6	6	6	4	5	6	5	7	**5,3**
Supply chain performance - flexibility (scale of 1 to 7)	6	5	4	n.a.	4	3	n.a.	4	6	5	6	6	4	5	6	4	7	**5,0**
Average	**6,0**	**4,3**	**4,3**	**n.a.**	**4,7**	**5,0**	**3,0**	**4,3**	**5,3**	**5,3**	**5,3**	**5,7**	**4,0**	**5,0**	**5,0**	**4,3**	**6,0**	

Respondents were also asked to rate their financial performance relative to other firms in their industry. Those who agreed to respond appear quite satisfied with their financial performance with an average of 5.4 out of 7 in realized profits, 4.8 out of 7 for profit growth, 4.7 for sales growth and 4.8 out of 7 for return on investment (ROI). The results are shown in Table 6.

TABLE 6
FINANCIAL PERFORMANCE RATING BY EACH FIRM

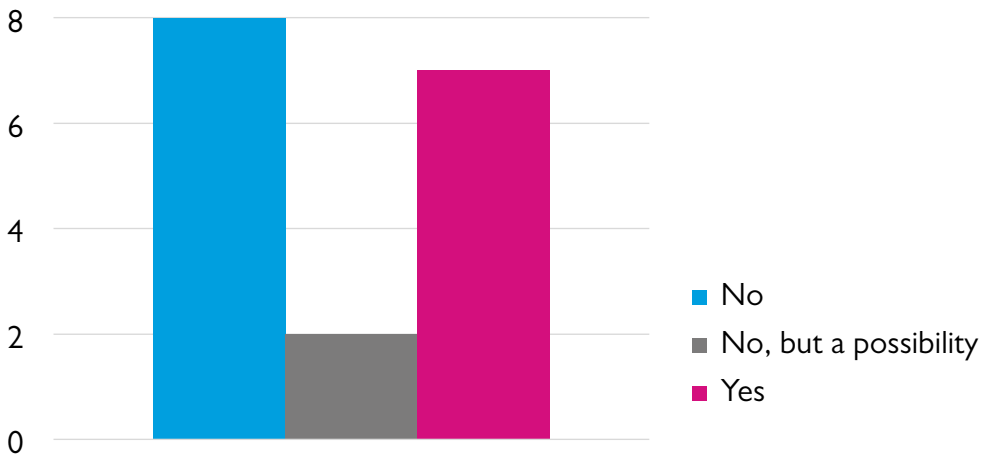
Firm #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Average
Financial performance - profit (scale of 1 to 7)	3	n/a	4	n/a	n/a	6	5	6	6	5	7	6	6	6	5	n/a	5	**5,4**
Financial performance - profit growth (scale of 1 to 7)	3	n/a	5	n/a	n/a	6	5	6	n/a	n/a	5	6	4	4	n/a	n/a	4	**4,8**
Financial performance - sales growth (scale of 1 to 7)	3	n/a	5	n/a	n/a	6	n/a	5	n/a	5	6	6	4	4	4	n/a	4	**4,7**
Financial performance - ROI (scale of 1 to 7)	3	n/a	4	n/a	n/a	6	n/a	6	n/a	n/a	6	6	4	4	n/a	n/a	4	**4,8**
Average	**3,0**	**n/a**	**4,7**	**n/a**	**n/a**	**6,0**	**5,0**	**5,7**	**6,0**	**5,0**	**6,0**	**6,0**	**4,7**	**4,7**	**4,5**	**n/a**	**4,3**	

3.2 INTERNATIONAL SUPPLY SOURCES

Respondents were asked if their firm had outsourced production or sourced certain components or finished products from lower cost countries in the last 10 years. The results shown in Figure 6 indicate that this was the case for 7 out of 17 respondents and 2 other firms considered such a possibility at the moment. In some cases, those who positively answered this question referred mainly to their parent company because their Québec facility did not use this practice. In other cases, the goal was to get closer to their customers with locations in lower cost countries, rather than reduce cost itself. For the majority of respondents, this option is not advantageous because the processes they use are too sophisticated or they want to protect the intellectual property of their processes.

FIGURE 7

HAS THE FIRM OUTSOURCED PRODUCTION OR SOURCED FROM LOWER COST COUNTRIES?



It should be noted that firms that chose to outsource their operations to lower cost countries made this decision as a result of a total cost analysis and all but one are satisfied with this decision. However, some respondents specified that there is still a need to properly assess the total cost on a regular basis several years after making the decision. The practice of conducting a total cost analysis before and after deciding to outsource to low cost countries is a good practice listed in the literature review.

Other good practices aimed at minimizing the risks associated with international sourcing are listed in Table 7. The most popular (and the least profitable, according to the literature review) is to maintain safety stocks to compensate for the remoteness of supply sources and the associated production lead times. Another best practice, which is carried out by at least three respondents, is to ensure the quality of products purchased in low cost countries before they leave their origin. In the same spirit, these same respondents do not hesitate to send their staff to their foreign suppliers to train them or help them to better manage production processes and management processes. Other good practices used by some respondents include the use of air transportation as an emergency only instead of on a regular basis and the use of alternative supply sources, here in Québec, in order to avoid delays.

TABLE 7

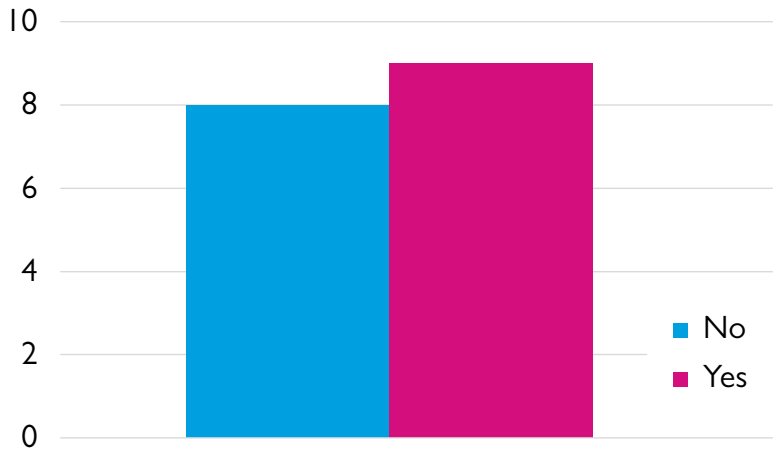
PRACTICES AIMED AT MINIMIZING RISKS ASSOCIATED WITH INTERNATIONAL SOURCING BY FIRMS

Firm #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Average
Use of safety stocks (scale of 1 to 7)	4	n/a	6	n/a	2	n/a	n/a	4	n/a	6	6	2	n/a	n/a	n/a	n/a	5	**4,4**
Use of alternative supply sources (scale of 1 to 7)	6	n/a	6	n/a	1	4	n/a	2	n/a	n/a	5	2	n/a	n/a	n/a	n/a	1	**3,4**
Use of air transportation instead of ground (scale of 1 to 7)	7	n/a	n.d.	n/a	7	6	n/a	5	n/a	n/a	2	n/a	n/a	n/a	n/a	n/a	1	**4,7**
Quality assurance of products before they leave their origin (scale of 1 to 7)	7	n/a	6	n/a	7	2	n/a	3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1	**4,3**
Firms will send their staff abroad to train suppliers (scale of 1 to 7)	6	n/a	6	n/a	7	n/a	n/a	6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1	**5,2**
Average	**6,0**	**n/a**	**6,0**	**n/a**	**4,8**	**4,0**	**n/a**	**4,0**	**n/a**	**6,0**	**4,3**	**2,0**	**n/a**	**n/a**	**n/a**	**n/a**	**1,8**	

3.3 VISIBILITY ON THE GLOBAL SUPPLY CHAIN

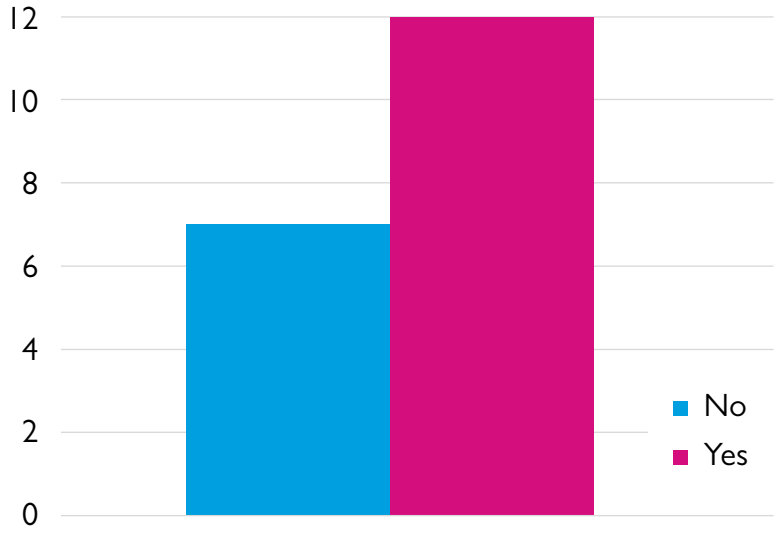
We have seen in the literature review that it is increasingly important for firms to improve the level of visibility on their global supply chain activities. Among the means at their disposal is the practice of asking suppliers to send advanced shipping notices (ASNs) that accurately identify products that have been shipped. Figure 7 shows that the majority of respondents to our study, 9 out of 17, ask their suppliers to send ASNs to them. This is one of the best practices identified in our literature review.

FIGURE 8
THE USE OF ADVANCES SHIPPING NOTICES BY EACH FIRMS



We also see in Figure 8 that a large majority of the respondents (12 out of 17) wish to improve the visibility level on their global supply chain.

FIGURE 9
WISH TO IMPROVE THE LEVEL OF VISIBILITY ON THEIR GLOBAL SUPPLY CHAIN BY EACH FIRM



As we have seen in the literature review, the tools to improve visibility on the global supply chain, to optimize transportation and to take into account a dynamic demand are very expensive and require considerable investment. The low volumes observed in the aerospace industry do not make it possible to make such investments profitable in most cases. In fact, the majority of businesses surveyed (largely SMEs) with a turnover of less than $ 100 million confirmed that they did not consider such an investment a priority for their business.

3.4 COMPLIANCE TO GOVERNMENTAL REGULATIONS

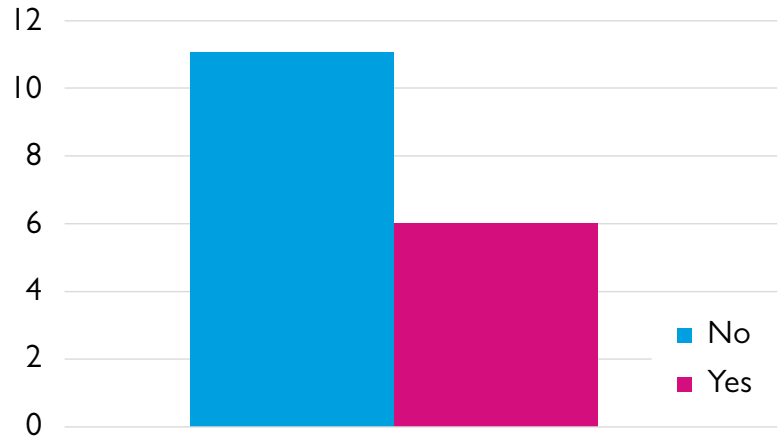
Respondents were asked to rate the degree of complexity required to comply with different regulations. The answers are displayed in the following table and vary greatly depending on the firm consulted. Thus, four firms evaluate at least 6 out of 7 the average degree of complexity for all the stated regulations. It is interesting to note that these firms are distinguished by the relatively high intensity of their trade with countries other than the United States. At the other end of the spectrum, five firms score less than 3 out of 7 the same average degree of complexity. For the other eight companies, the degree of complexity is medium and varies depending on the type of regulation. The Canadian Controlled Goods Program (CGD) and the United States International Traffic in Arms Regulation (ITAR) are perceived as the most complex for all respondents, closely followed by customs duties requirements. On the other hand, packaging regulations are considered least complex by the respondents. However, there are strong variations in the respondents' responses in the latter case, as in other regulations.

TABLE 8
LEVEL OF COMPLEXITY FOR EACH FIRM TO COMPLY WITH VARIOUS REGULATIONS

Firm #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Average
Import and export licenses (scale of 1 to 7)	7	6	4	7	2	2	5	2	6	2	n/a	6	4	4	2	2	1	**3,9**
Classification of products (scale of 1 to 7)	6	6	4	5	2	3	n/a	4	2	3	5	6	3	4	2	2	5	**3,9**
Controlled Goods Program (CA) and/or ITAR (US) (scale of 1 to 7)	7	6	5	7	2	3	5	5	6	5	2	6	2	6	2	2	1	**4,2**
Certificate of origin (scale of 1 to 7)	5	5	5	n/a	2	3	5	7	3	3	2	4	2	3	2	3	3	**3,6**
Customs duty (scale of 1 to 7)	6	6	4	5	4	6	2	2	6	5	2	5	1	3	2	5	5	**4,1**
Packaging (scale of 1 to 7)	6	5	5	5	6	n/a	1	1	1	n/a	2	2	2	4	2	3	1	**3,1**
Average	**6,7**	**6,0**	**4,3**	**6,3**	**2,0**	**2,7**	**5,0**	**3,7**	**4,7**	**3,3**	**3,5**	**6,0**	**3,0**	**4,7**	**2,0**	**2,0**	**2,3**	

In addition, Figure 9 informs us that 6 out of 17 firms have already experienced problems with the compliance of their international trade. This is an important finding that should be of concern to industry stakeholders. One of the respondents told us of an incident that could have cost him a $ 100,000 penalty. He had returned a digital control machine that was defective to his supplier in the United States without obtaining a proper export permit from Global Affairs Canada. He was unaware of such regulated requirement. This earned him a warning during an audit a few years later. He was able to avoid the penalty for this time but it will not be so easy next time. In short, in the case of the 11 other firms that have never had compliance issues, one might assume that some of them underestimate the importance of compliance because, in fact, they have never had problems in the past.

FIGURE 10
HAS THE FIRM EVER FACED INTERNATIONAL TRADE COMPLIANCE ISSUES?



With regard to the membership to security programs, the following figures inform us that 6 out of 17 companies participate in the C-TPAT program facilitating the passage of trucks at the United States border, while only 4 companies have chosen to join the *Air Cargo Security* program. It should be understood that some firms ship little or nothing to the United States, others rely on their Canadian-based customer and others use the services of integrators such as FedEx for their exports to the United States which makes it easier for them.

FIGURE 11
CTPAT MEMBERSHIP BY THE FIRM

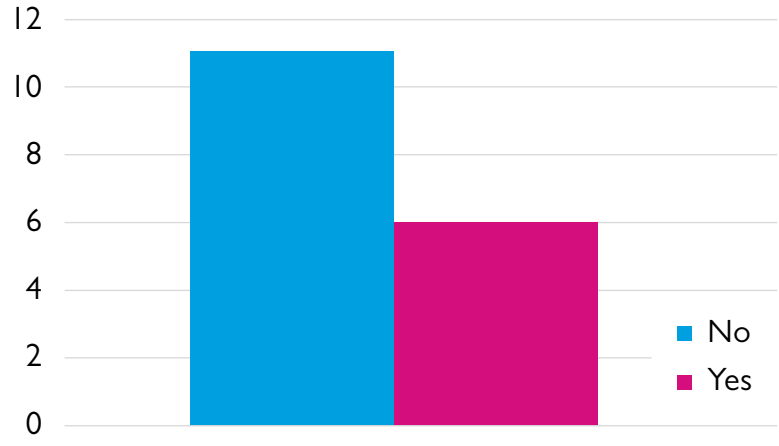
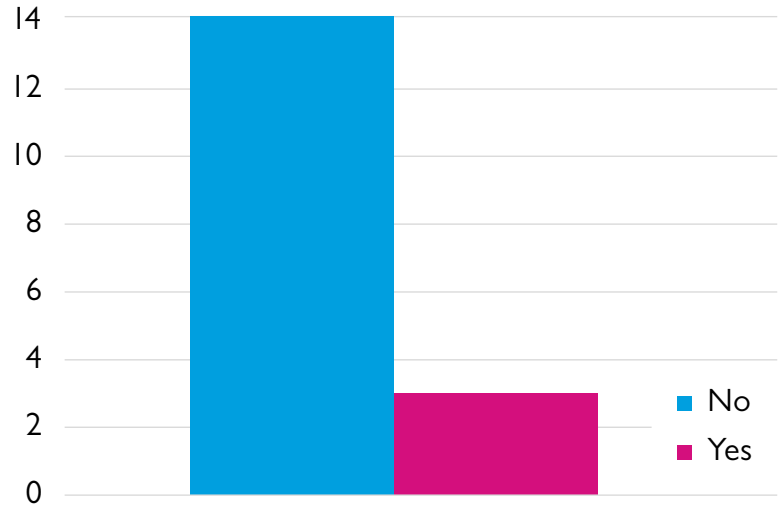


FIGURE 12
AIR CARGO SECURITY MEMBERSHIP BY THE FIRM



3.5 THE PROPER USE OF INCOTERMS

The following table shows how familiar our respondents are with Incoterms. Most of them know little or nothing about these terms of international trade. Only 5 out of 17 respondents say they have a very good knowledge of this terminology. Most of them work in companies with very strong international activity beyond the United States. Moreover, on a scale of 1 to 7, where 7 corresponds to «very good», the respondents' level of knowledge of Incoterms is 3.9 on average, which is rather low. Also, it is lower than the score of 4.4 observed in a previous survey of Québec exporters according to the study by Hien & al. (2009).

TABLE 9
DEGREE OF KNOWLEDGE OF INCOTERMS BY EACH FIRM

Firm #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Average
Degree of knowledge of Incoterms by each firm (scale of 1 to 7)	7	6	4	7	2	2	5	2	6	2	n.d.	6	4	4	2	2	1	**3,9**
Average	7,0	6,0	4,0	7,0	2,0	2,0	5,0	2,0	6,0	2,0	n.d.	6,0	4,0	4,0	2,0	2,0	1,0	

According to our survey respondents, all types of Incoterms are used, but to varying extents. In terms of imports, it is the Incoterms of the "D" family that are the most popular, namely DDP, DAP and DAT, as reported in Figure 12. This situation is normal because importing firms will often prefer that their suppliers handle the majority of logistics activities such as pre-routing and long-distance transport of ordered products. Remember that the term DDP is the one that involves the least responsibility for the buyer while the supplier is responsible for delivering the goods to the buyer's site including all costs, even those related to the clearance of goods. Another term that is quite popular is FCA which implies that the buyer takes charge of the goods from the airport or port of the country of origin. This provides the buyer with better control of the goods and allows him, in certain cases, to negotiate better transportation rates if the latter has a better bargaining power than the supplier.

It is worth remembering that the terms FAS, FOB, CIF and CFR are reserved for maritime transportation only. It is therefore normal for them to be used less in the aerospace sector, which uses air transportation more extensively for its international trade

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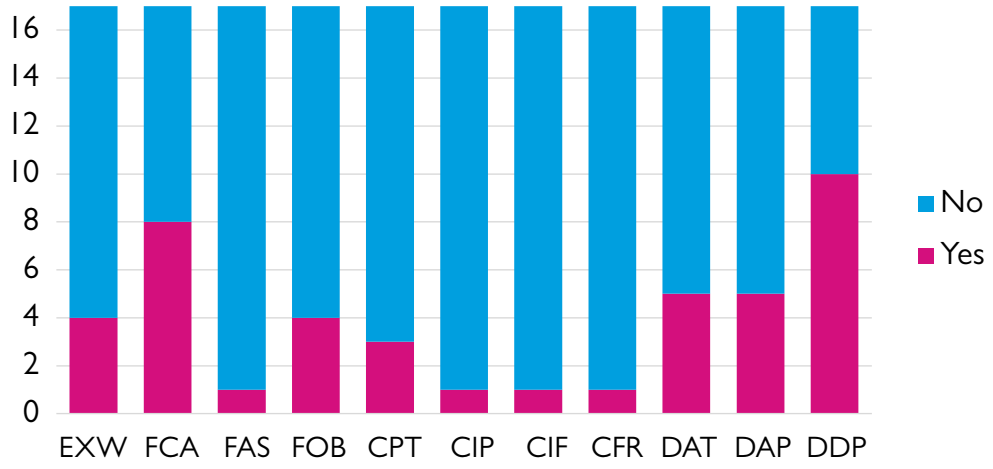
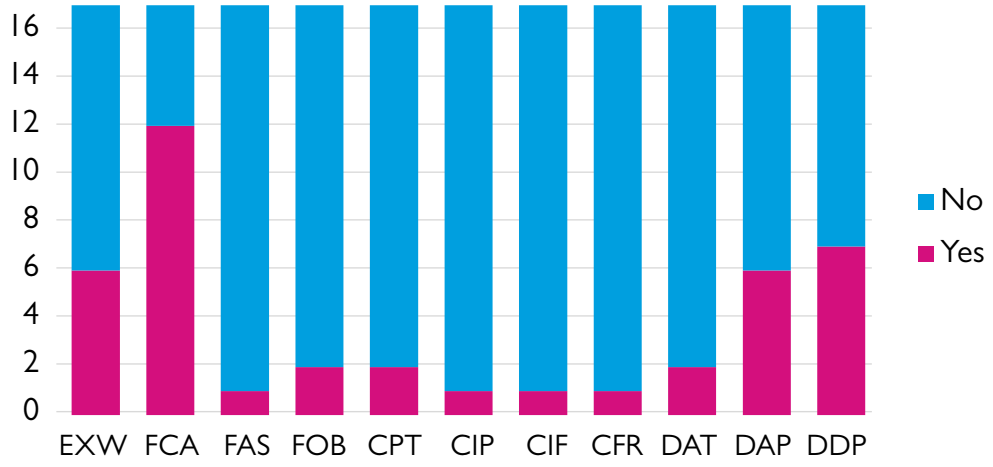
FIGURE 13 :
USE OF EACH TYPE OF INCOTERM BY FIRMS DURING THEIR IMPORTS



In terms of exports, our respondents mainly use the term FCA, which means that they will make the goods available at the carrier designated by their customer, loaded on the means of transport that it provides, with customs formalities at the airport export completed. It also happens that the term EXW is chosen, which implies the minimum of responsibility on the part of the supplier who merely makes the goods available at his shipping platform. It is then the client who will be responsible for picking it up and forwarding it to his site. This latter case often occurs when the client is a major contractor who has facilities in the Montreal area and prefers to organize a pick-up tour with his Québec suppliers in order to minimize his transportation costs. From the following figure, it can be seen that the terms DAP and DDP, located at the other end of the spectrum, are also frequently used. This choice is probably due to the client's bargaining power, which allows him to demand that the merchandise be delivered to his facilities cleared from customs (DDP) or not (DAP).

FIGURE 14
USE OF EACH TYPE OF INCOTERM BY FIRMS DURING THEIR EXPORTS



In our literature review, we saw that it was appropriate to revisit the choice of Incoterms according to the changes observed in the environment of the firm. Figure 14 tells us that 53% of our respondents do not question the choice of their Incoterms. This finding is consistent with the results of the study by Hien & al. (2009) which revealed that Québec exporters tended to always use the same Incoterms. This situation can be justified if the business environment is relatively stable (same customers and suppliers, same countries of origin and destination, etc.). But it may be due to a certain level of inertia and a lack of knowledge of the importance of Incoterms in international trade. In fact, Figure 15 shows that 41% of respondents have had a bad experience with a wrong Incoterms selection in the past.

FIGURE 15
QUESTIONING THE CHOICE OF INCOTERMS BY THE FIRM

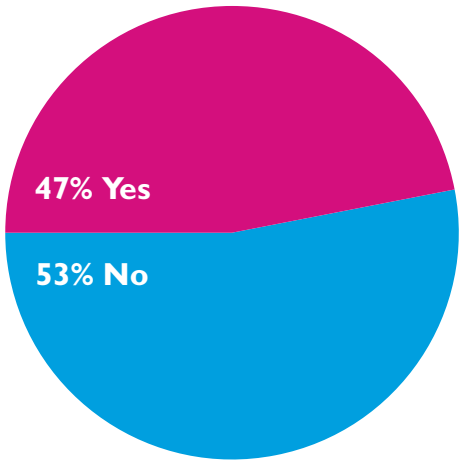
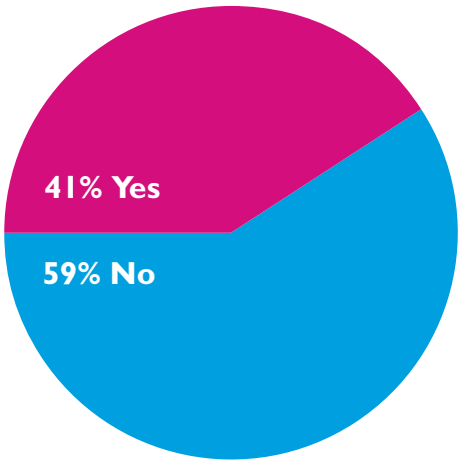


FIGURE 16
BAD EXPERIENCE DUE TO THE WRONG CHOICE OF AN INCOTERM BY THE FIRM?



3.6 THE AUTOMATION IF IMPORT AND EXPORT PROCESSES

As we have seen in the literature review, very few companies can boast of having automated certain processes associated with the import or export of goods. The following figure confirms that this is also the case in Québec, where only one company reports using such automated tools or software to manage these processes. The vast majority of the companies consulted rely on a combination of e-mail and electronic exchanges via EDI.

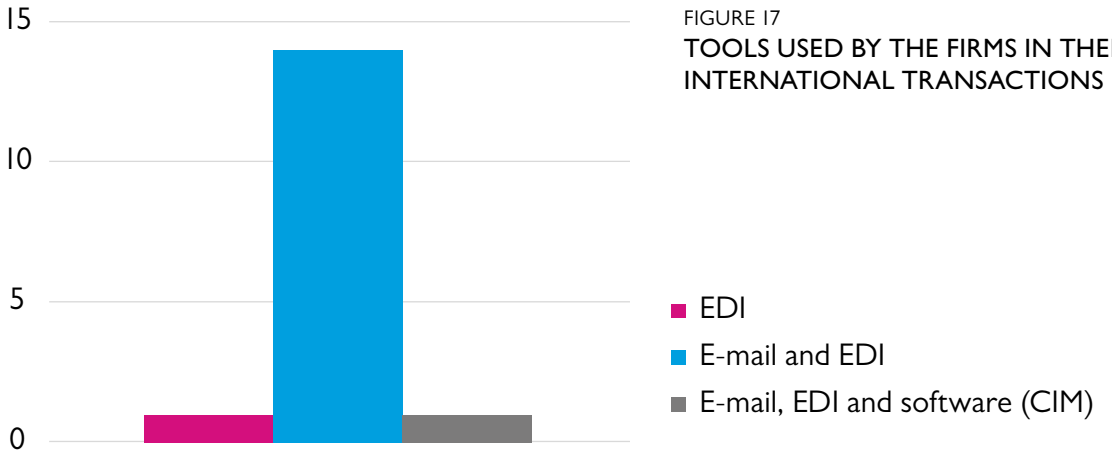


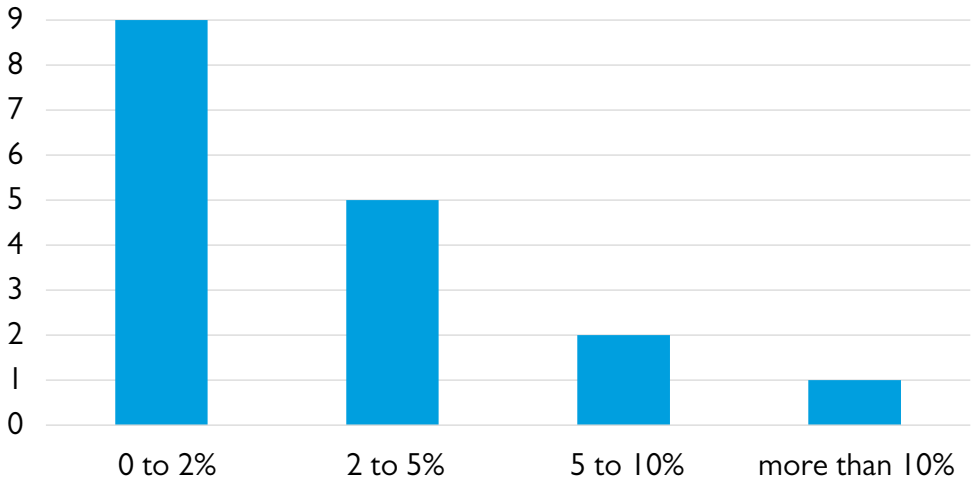
FIGURE 17
TOOLS USED BY THE FIRMS IN THEIR INTERNATIONAL TRANSACTIONS

3.7 THE MINIMIZATION OF INTERNATIONAL TRANSPORTATION COSTS

The minimization of international transportation costs is not necessarily a priority for the majority of the respondents as these costs are relatively low compared to the total revenue in the aerospace sector, as can be seen in Figure 17.

However, it is a priority for the majority of large surveyed firms which have developed tools, implemented strategies of execution or enrolled in government programs to reduce the cost and time associated with international transportation.

FIGURE 18
TRANSPORTATION COSTS VERSUS SALES BY EACH FIRM



It was found through the interviews conducted that the dynamic routing of shipments was practiced within at least one Québec aerospace firm. Indeed, one of the firms surveyed developed an IT tool that went beyond traditional ERP. This tool is able to reconcile delivery dates, customer demand, the arrival of other unforeseen events, as well as ERP data. Consequently, it is enabling proactive management of delivery time risks and, therefore, reducing costs by minimizing the number of expedited transport requests.

Another firm also developed a transport-related tool that performs daily routing optimization required for the collection of inbound products. This ensures minimization of daily transportation costs. Then, it was found that this strategy of minimizing the costs of international transport was adopted within another firm. Without developing an IT tool dedicated to this function, it carried out an exercise of alignment between the planning of the request of the parts and the inbound transportation of parts in order to minimize the number of expedited transport requests.

Customs being a factor to consider in international transport, it was found that one firm had successfully implemented the Customs Self-Assessment (CSA) program. This firm claimed to benefit a lot from it because it was able to reduce both the time and the cost of transportation. The firm was also cited by the Canadian Government as success story and the firm received a delegation from the European Union that could see in person the benefits of this government program.

Finally, another firm adopted a logistics council rallying experts from its various sites. This council promotes the sharing of supply chain best practices adopted within the firm's sites, thereby reducing logistical costs on a global scale.

3.8 THE ESTABLISHMENT OF PARTNERSHIPS WITH OTHER STAKEHOLDERS SUCH AS FREIGHT FORWARDERS, CUSTOMS BROKERS AND LOGISTICS SERVICE PROVIDERS (3PLS)

We have seen previously in the literature review that the most successful firms tended to establish partnership relations with their logistics service providers (3PLs), freight forwarders and customs brokers. Table 10 shows us that this is the case only for a minority of the firms consulted in this study. Nearly half of the respondents say they only maintain purely transactional relationships with their freight forwarders and customs brokers. In addition, the vast majority of respondents do not hire 3PLs. It may be assumed that smaller firms have more difficulty in establishing such partnerships with their service providers, who are often very big players in the industry.

However, it is interesting to note that almost half of the respondents (47%) say it would be useful for their business to further develop its relationship with their 3PLs, freight forwarders and customs brokers.

TABLE 10
UTILITY PERCEIVED BY EACH FIRM TO DEVELOP THEIR RELATION WITH THEIR LOGISTICAL PARTNERSHIPS

Firm #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Average
Relationship with the freight forwarder (scale of 1 to 7)	6	4	5	6	7	1	2	2	3	3	1	1	1	1	4	1	4	**3,1**
Relationship with the customs broker (scale of 1 to 7)	5	4	5	6	7	1	1	5	5	3	1	1	1	1	6	1	1	**3,2**
Relationship with the 3PL (scale of 1 to 7)	6	4	n/a	n/a	7	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**4,5**
Average	**5,7**	**4,0**	**5,0**	**6,0**	**7,0**	**1,0**	**1,5**	**3,5**	**4,0**	**3,0**	**1,0**	**1,0**	**1,0**	**1,0**	**5,0**	**1,0**	**2,5**	

4. CONCLUSIONS AND RECOMMENDATIONS

This study identified some issues and best practices in global supply chain management. Some of these issues are targeted at SMEs in the sector, which often lack the expertise and resources to adopt best practices in the field. Based on a limited number of interviews, the study does not claim to provide a true image of the sector but rather to paint a sufficiently revealing picture of the global supply chain situation in the Québec aerospace sector. The results demonstrate in particular that:

- The majority of respondents consider their supply chain performance to be average in terms of costs but better for the level of service.
- The majority of respondents did not outsource their production or supply to lower cost countries because this option is not beneficial to them; the processes they use are too sophisticated or they want to protect the intellectual property of their processes.
- Firms that chose to outsource production or supply to lower-cost countries made this decision following a rigorous total cost analysis and all but one are satisfied with this decision.
- Among the practices aimed at minimizing the risks associated with international sourcing are the use of safety stocks to compensate for the remoteness of sources of supply and production lead times, the quality assurance of acquired products in lower-cost countries before they leave their origin and the use of expedited air transportation.
- A very large majority of respondents would like to improve the visibility level on their global supply chain and the majority of them ask their suppliers to send them ASNs (Advanced Shipping Notices), which is one of the best practices identified in our review.
- Firms must comply with different regulations. The *Controlled Goods Program* in Canada and the *International Traffic in Arms Regulation* (ITAR) in the United States are perceived as the most complex for all respondents, closely followed by customs duties. In addition, we note that 6 out of 17 respondents have already experienced problems with the compliance of their international trade. This is an important finding which shows that compliance should be of concern to industry stakeholders.
- The majority of respondents know little or nothing about international commercial terms (Incoterms) and they do not question the choice of Incoterms. Only 5 out of 17 respondents say they have a very good knowledge of this terminology. On the other hand, 41% of respondents have already had a bad experience resulting from a wrong choice of an Incoterm in the past.
- Only one firm reports having automated the processes associated with the import or export of goods and few respondents, especially the larger ones, have adopted tools to reduce the cost and time associated with international transportation. This is because transportation costs are relatively low compared to sales in the aerospace industry.

Interviews with 17 firms in the sector also provided us with the recommendations and suggestions summarized here.

RECOMMENDATION #1: TRAINING

Many stakeholders in the industry, including SMEs, have identified the need for information sessions and training programs in the field of global supply chain. It is recommended that training programs be offered on the following topics:

- International trade and free trade agreements
- Incoterms
- Customs paperwork
- Compliance to government regulations
  (customs, Canadian *Controlled Goods Program*, export permits)
- Security programs (C-TPAT, FAST, Air Cargo Security)
- How to better utilize logistical partners such as 3PLs/4PLs instead of simply hiring the cheapest freight forwarder.

We also suggest training on the following themes which are of broader scope:

- Training on the relevance and importance of making accurate forecasts "without inflating numbers". This is an important issue because of the volatility of the demand in the aerospace industry.
- Integrated planning. This is a subject that should be further discussed, especially for SMEs that are more in a reactive mode.

RECOMMENDATION #2: OBTAIN HELP FROM AERO MONTRÉAL AND THE GOVERNMENT

Some stakeholders suggested that a resource be available on a full-time basis at Aero Montréal to help SMEs adopt best practices in global supply chain management, including compliance issues.

Others suggested that the Government should help SMEs to automate and facilitate customs, paperwork and international trade.

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APPENDIX 1 : LIST OF RESPONDENTS

Aérospatiale Hemmingford

APN

Arconic Titanium and Engineered Products (formerly known as ATEP Laval)

Atlas Aéronautik

Avianor

Bombardier Inc.

CAE Inc.

Groupe DCM

Groupe Meloche

Héroux-Devtek Inc.

Industries Leesta

L3 Mas

Mesotec

Nétur

PCM Techfab

Pratt & Whitney Canada Corp.

Sonaca Montréal

APPENDIX 2 : INTERVIEW GUIDE

THE PERFORMANCE AND BEST PRACTICES IN GLOBAL LOGISTICS OF AEROSPACE FIRMS IN QUEBEC

INTERVIEW GUIDE

Date _____ Place _____ Duration _____

Name _____ Surname _____

Organization _____ Job _____

INTRODUCTION

The objective of this research project is to better understand the issues and challenges faced by Quebec-based aerospace companies with respect to international trade and logistics, and to identify best practices implemented by those companies recognized as leaders in this field. To this end, we have conducted a preliminary literature review and identified a number of best practices related to the following activities: 1) total cost analysis in outsourcing manufacturing and procuring goods in lower cost countries, 2) ensuring visibility of global supply chain activities and shipments, 3) ensuring compliance to various rules and regulations, 4) import and export process automation 5) minimizing transportation costs internationally, 6) establishing partnerships with various stakeholders such as freight forwarders, customs brokers and third-party logistics providers (3PLs), and 7) the use of proper incoterms.

The research method consists of conducting face-to-face interviews with managers responsible for international logistics and procurement in the Quebec aerospace industry. To do so, an interview guide has been developed. We aim to study the following two industry segments: 1) large world-class companies which would allow us to hopefully identify and describe best practices implemented in this area, and 2) smaller and mid-size companies in order to evaluate their level of performance with respect to international logistics and identify the issue that they face. The results of this research will allow us to identify the strengths and weaknesses of the Quebec aerospace industry when it comes to international trade and logistics and propose actions that would help the industry to adopt best practices in this strategic area.

FIRM PROFILE

1. What type of activities does the firm perform?

- ☐ Civil (commercial, private and/or general)
- ☐ Military

2. In which sector is the firm established?

- ☐ Aeronautical
- ☐ Spatial

3. What is the core business of the firm?

- ☐ Aircraft builder
- ☐ Cell and/or engine maker
- ☐ OEM

4. Turnover :

- ☐ Less than 10 million $
- ☐ Between 10 and 24.9 million $
- ☐ Between 25 and 49.9 million $
- ☐ Between 50 and 99.9 million $
- ☐ Between 100 and 499 million $
- ☐ More than 500 million $

5. Number of employees::

- ☐ Less than 100
- ☐ Between 100 and 500
- ☐ More than 500

6. Is the firm a subsidiary of a multinational enterprise?

- ☐ Yes
- ☐ No

7. Please complete the following tables:

TABLE 1 : PROCUREMENT

Origin	Value (Millions)	Shares (%)	Type of transportation (share %)		
			Ground	Maritime	Air
Québec					
Other Canadian provinces					
United States					
Mexico					
South America					
Europe					
Asia					
Middle-East					
Africa					
Other (specify) :					

TABLE 2 : SALES

Origin	Value (Millions)	Shares (%)	Type of transportation (share %)		
			Ground	Maritime	Air
Québec					
Other Canadian provinces					
United States					
Mexico					
South America					
Europe					
Asia					
Middle-East					
Africa					
Other (specify) :					

8. Indicate in which measure you agree with the following statements relating to the performance of your supply chain:

	Strongly disagree						Strongly agree
The cost of our supply chain improved throughout recent years.	1	2	3	4	5	6	7
The level of service of our supply chain improved throughout recent years.	1	2	3	4	5	6	7
The flexibility of our supply chain improved throughout recent years.	1	2	3	4	5	6	7

9. Indicate the performance of your firm in each of the following fields:

	Well below the industry's average						Well above the industry's average
Sales growth in the last 3 years.	1	2	3	4	5	6	7
Return on investment in the last 3 years.	1	2	3	4	5	6	7
Average profit in the last 3 years.	1	2	3	4	5	6	7
Profit growth in the last 3 years.	1	2	3	4	5	6	7

PRACTICES IN INTERNATIONAL LOGISTICS

GLOBAL PROCUREMENT

10. In the last 10 years, have you outsourced the production or the procurement of components and/or finished products in low cost countries?

Yes ☐ No ☐

11. If so, did you ever complete a total cost analysis before taking this decision?

Yes ☐ No ☐

12. Have you ever used key performance indicators such as : Real total cost vs forecasted?

Yes ☐ No ☐

13. Today, are you satisfied with this decision?

Yes ☐ No ☐

14. What is the importance of the following measures taken in order to mitigate risk linked with global procurement?

	Not important						Very important
More safety stock is kept.	1	2	3	4	5	6	7
Alternative production methods are used.	1	2	3	4	5	6	7
Air freight is used instead of ground.	1	2	3	4	5	6	7
Quality of products is verified prior shipping.	1	2	3	4	5	6	7
We send our employees abroad to help and/or train our suppliers.	1	2	3	4	5	6	7
Other measures :	1	2	3	4	5	6	7

15. What of the following discribes best your current state and knowledge of the location and timeliness of shipments (incoming or outgoing)?

- ☐ We are informed of the major steps (departure, layover, arrival)
  - ☐ By fax or phone
  - ☐ By email
  - ☐ By EDI
  - ☐ By an integrated web solution
  - ☐ Other
- ☐ We are informed of exceptions (delays, changes, incidents)
  - ☐ By fax or phone
  - ☐ By email
  - ☐ By EDI
  - ☐ By an integrated web solution
  - ☐ Other

16. Our supplier regularly send us ASNs (Advance Notice Shipments)

- ☐ By fax or phone
- ☐ By email
- ☐ By EDI
- ☐ By an integrated web solution
- ☐ Other

17. Do you wish to improve the visibility of your global supply chain?

Yes ☐ How? _____

No ☐ Why? _____

18. What is the degree of complexity of the following regulations for your firm?

	Not complex						Very complex
Import and export authorizations	1	2	3	4	5	6	7
Product classifications	1	2	3	4	5	6	7
Controlled goods program (CGD; Canada) and/or International Trafic in Arms Regulation (ITAR; U.S.)	1	2	3	4	5	6	7
Certificate of origine	1	2	3	4	5	6	7
Tariffs and duties	1	2	3	4	5	6	7
Packaging	1	2	3	4	5	6	7
Other measures :	1	2	3	4	5	6	7

19. Have you ever encountered issues with international trade compliance?

☐ Yes Briefly describe (e.g. penalties) _____

☐ No

20. Who is responsible for international trade compliance (e.g. export controls) in your firm?

_____

21. How many employees are dedicated to international trade compliance ? (internal or external)

_____

22. Have you join the following safety programs?

C-TPAT: ☐ Yes ☐ No

FAST: ☐ Yes ☐ No

Air Cargo Security: ☐ Yes ☐ No

Other: _____

INCOTERMS USAGE

23. What is your knowledge degree of Incoterms?

	Not at all						Very well
Knowledge of Incoterms	1	2	3	4	5	6	7

24. Who chooses the Incoterms for your international transactions?

- My department (_____) _____
- Procurement _____
- Another department _____
- Our forwarding agent _____
- Our supplier _____
- Our client _____
- Other _____

25. Which Incoterm do you use most often?

INCOTERM	IMPORT	EXPORT
EXW		
FCA		
FAS		
FOB		
CPT		
CIP		
CIF		
CFR		
DAT		
DAP		
DDP		

1 = often **2** = sometimes **3** = never

26. Do you ever doubt your choice of Incoterms?

☐ Yes Example _____

☐ No

27. Did you ever encounter a bad experience following a bad choice of Incoterm?

☐ Yes Example _____

☐ No

AUTOMATION OF IMPORT AND EXPORT PROCESSES

28. How are performed international transactions in terms of automation?

☐ Manually (Fax)

☐ Emails/EDI

☐ Through a software

☐ Other

Comment _____

29. What are your current and future projects in regards of implementing a new automation technology?

_____

THE MINIMIZATION OF INTERNATIONAL TRANSPORTATION COST

30. What are the costs of international transportation versus your sales?

_____ %

31. Logistics costs (transport, warehousing) Vs. Cost of purchasing?

_____ %

32. What are the tools used by your firm to manage foreign transportation?

☐ None (manual tenders)

☐ Excel Files

☐ Optimization software

33. Are you able to promptly modify the routing of shipments and depending on various circumstances?

☐ Yes How? _____

☐ No

34. Which KPIs do you use in order to measure international transportation?

Costs? _____

Service? _____

35. Which measures would you like to put in place in order to better control your international transportation costs?

Comment _____

THE FOUNDATION OF PARTNERSHIPS WITH OTHER CONTRIBUTORS SUCH AS FORWARDING AGENTS, CUSTOMS AGENTS AND THIRD-PARTY LOGISTICS (3PLS)

36. How do you describe your relationship with the following partner?

	Transactional						Partnership
Forwarding agent	1	2	3	4	5	6	7
Customs agent	1	2	3	4	5	6	7
Third-party logistics (3PLs)	1	2	3	4	5	6	7

37. Do you think it would be useful to develop a better relationship between you and your logistics partners abroad?

☐ Yes How? _____

☐ No

Thank you for your time and collaboration!