

The Economic Contribution of Independent Lubricant Manufacturers Association Members in North America

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Contents

Executive Summary	3
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Introduction	4
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Lubricant production and markets	4
Lubricant industry structure	5
The Independent Lubricant Manufacturers Association (ILMA)	6

Economic contribution of ILMA in North America	8
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Focus on the metal working fluids sector	12
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Appendix A: Economic contribution model specifications	13
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– Industries included in the model	13
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Appendix B. Glossary of economic contribution analysis terminology	17
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Executive Summary

Since antiquity, lubricants have played an important supporting role in generating economic value by enhancing the performance of virtually all mechanical operations. With the advent of the oil industry in the mid-19th century, petroleum-based lubricants rapidly displaced traditional animal- and vegetable-based lubricants. Rapid improvements in petroleum processing and chemical technology, from vacuum distillation to solvent extraction to hydro-processing, along with the development of specialty additives, have fostered continual and dramatic performance improvements that have led to ever-more useful lubricant products. Although accounting for only about 1% of petroleum consumption by volume, lubricants are essential to the smooth functioning of the North American economy. Many vital industry sectors – including agriculture, manufacturing, distribution, freight, passenger, and personal transportation – depend on lubricants to maintain efficient operations.

The Independent Lubricant Manufacturers Association (ILMA) and the ILMA Foundation commissioned IHS Markit to assess the contributions that the companies meeting the Association’s eligibility criteria for manufacturing membership (the ILMA-manufacturing eligible companies, or the “ILMA Sector”) make to the North American economies of the United States, Canada, and Mexico. ILMA estimates that the ILMA manufacturing eligible companies produce more than 25% of the automotive lubricants (including toll blending for non-ILMA lubricant marketers) and over 70% of the metalworking fluids used in North America. IHS Markit quantified the contributions to key metrics such as sales activity, employment, wages, and gross domestic product (GDP) stimulated by the ILMA-manufacturing eligible companies. First, IHS Markit traced the economic impact created by these companies spending within their supply networks. Next, IHS Markit modelled the follow-on contributions stemming from spending by workers of ILMA-manufacturing eligible companies and their supply networks.

Key findings include:

The ILMA Sector stimulated \$14.4 billion in sales activity and \$7.2 billion in GDP

- The ILMA Sector realized over \$6.7 billion of sales activity in North America in 2018 (the “direct” entries under the “sales activity” columns in the table below). Of this, almost \$1.4 billion was in the metalworking fluids segment.
- The overall direct sales activity stimulated follow-on (combined indirect and induced) sales of \$7.7 billion, yielding a multiplier of 1.2. This means for every dollar realized by the ILMA Sector, another \$1.2 of sales activity occurred throughout the North American economy. For the metalworking segment, the corresponding figures were almost \$1.7 billion of follow-on sales yielding a multiplier of 1.2.
- Metalworking fluids are predominantly used by companies in four manufacturing sectors: primary metals; fabricated metals; machinery; and transportation equipment. In 2018, these sectors accounted for more than \$948.1 billion or 4.0% of North American GDP. Thus, metalworking fluids played a supporting role in generating 4.0% of North American GDP.

The ILMA Sector helped support over 26,300 jobs that paid \$2.6 billion in labor income

- IHS Markit estimates that the ILMA Sector directly employed approximately 4,262 North American workers in 2018. The indirect and induced activity supported another 22,038 jobs. This means that, for every job in the ILMA Sector, another 5 jobs are supported across North America.
- In 2018, the average employee compensation across the direct, indirect, and induced workers ultimately supported by ILMA Sector companies’ activities was \$101,030 per worker, about 26% higher than the North American average.

Summary of the ILMA Sector’s economic contributions to the North American economy, 2018

(millions of USD and number of workers)

	Sales Activity		Contribution to GDP		Labor Income		Employment	
	Overall	Metalworking fluids	Overall	Metalworking fluids	Overall	Metalworking fluids	Overall	Metalworking fluids
United States	\$12,915.1	\$2,857.4	\$6,521.5	\$1,759.4	\$2,447.9	\$412.9	22,824	3,850
Direct	\$5,789.5	\$1,280.9	\$3,010.0	\$812.1	\$903.9	\$152.5	3,493	589
Indirect	\$5,706.7	\$1,262.6	\$2,719.8	\$733.8	\$1,129.7	\$190.5	12,564	2,119
Induced	\$1,418.9	\$313.9	\$791.6	\$213.6	\$414.3	\$69.9	6,767	1,141
Canada	\$865.3	\$138.9	\$416.5	\$82.3	\$145.9	\$18.2	1,797	224
Direct	\$481.9	\$77.4	\$236.1	\$46.7	\$63.6	\$7.9	443	55
Indirect	\$309.8	\$49.7	\$141.8	\$28.0	\$63.6	\$7.9	971	121
Induced	\$73.6	\$11.8	\$38.6	\$7.6	\$18.7	\$2.3	384	48
Mexico	\$618.4	\$21.9	\$271.9	\$11.8	\$63.4	\$1.9	1,680	51
Direct	\$382.0	\$13.6	\$152.8	\$6.6	\$39.0	\$1.2	326	10
Indirect	\$208.6	\$7.4	\$102.0	\$4.4	\$20.1	\$0.6	1,065	32
Induced	\$27.7	\$1.0	\$17.1	\$0.7	\$4.3	\$0.1	289	9
North America	\$14,398.8	\$3,018.2	\$7,209.9	\$1,853.6	\$2,657.2	\$433.0	26,301	4,125
Direct	\$6,653.5	\$1,371.8	\$3,399.0	\$865.4	\$1,006.5	\$161.6	4,262	654
Indirect	\$6,225.1	\$1,319.7	\$2,963.6	\$766.2	\$1,213.4	\$199.1	14,599	2,272
Induced	\$1,520.3	\$326.7	\$847.3	\$221.9	\$437.3	\$72.3	7,439	1,198

Source: IHS Markit

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Introduction

The use of lubricants to enhance the performance of virtually all mechanical operations extends far back into antiquity. Over the centuries, humans used animal and vegetable fats and oils for lubricating wagons and transports as well as household and light industrial machinery. The Industrial Revolution significantly expanded the need for lubricants, as factory and commercial transport systems developed. However, animal and vegetable-derived materials remained the primary sources of lubrication until the mid-19th century.

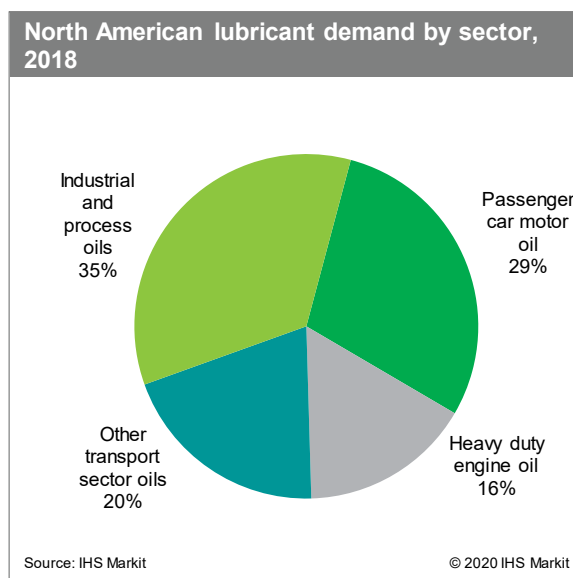
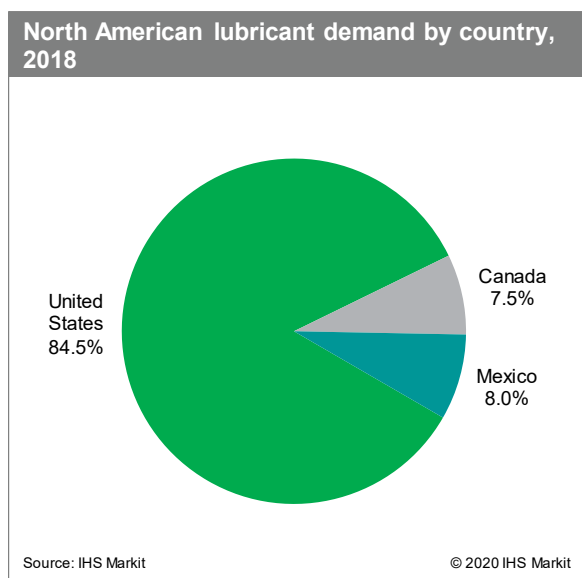
In the mid-19th century, petroleum was discovered to impart favorable properties to machine lubricants. After commercial oil drilling and production began in Pennsylvania, petroleum began to rapidly displace the animal and vegetable oils traditionally used as lubricants. Rapid improvements in petroleum processing and chemical technology, from vacuum distillation to solvent extraction to hydro-processing, along with the development of specialty additives, dramatically improved the performance of petroleum lubricants and allowed for the production of ever-more useful lubricant products. The growth of the automobile and trucking industries created a vastly expanded market for lubricants, as high-quality lubricants were necessary for the manufacturing and operation of all vehicles. IHS Markit estimates that the lubricants sector accounts for about 1% of North American petroleum consumption and plays a vital supporting role in the smooth and efficient functioning of many key sectors across the North American economy.

Lubricant production and markets

Finished lubricants that meet exacting performance requirements are produced by blending lubricating base oils with specialized additives. The lubricant blending plants where the base oils and additives are blended together typically encompass base oil and other raw material storage, sophisticated blending equipment, and packaging lines for production of containers of lubricants ranging from drums down to small bottles. In addition, some lubricants are delivered to customers in bulk via truck, railcar, or container.

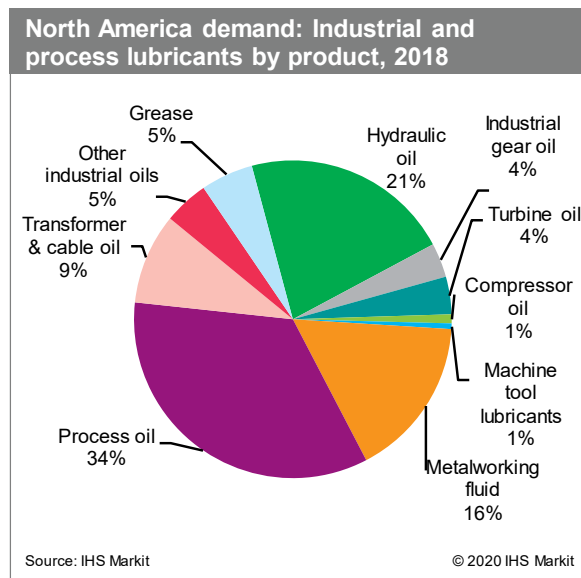
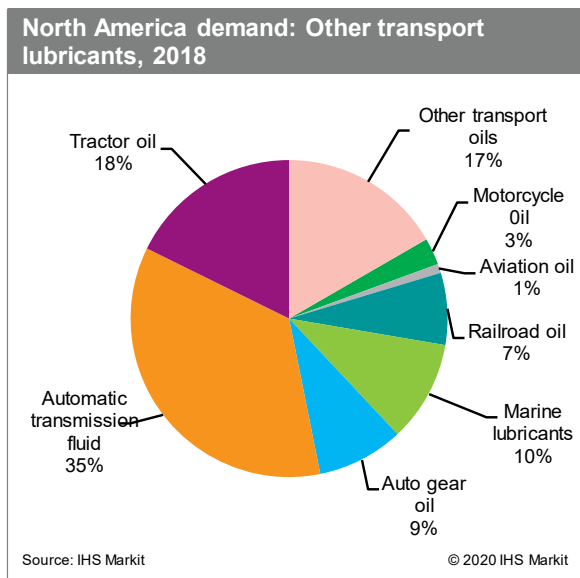
Finished lubricants are the products that consumers purchase and use, including motor oils, transmission fluids, gear oils, marine engine oils, industrial oils such as hydraulic oils and metalworking fluids, and process oils such as diluents and agricultural spray oils. Greases are also considered to be finished lubricants; they are produced by emulsification of base oils with a soap to produce a compound that is physically stable but provides lubrication to the surfaces covered.

The North American lubricant market, consisting of the United States, Canada, and Mexico, consumes approximately 2.7 billion gallons annually. Canada and Mexico are of similar size, with each consuming about 0.2 billion gallons, while the United States accounts for the remaining 84% of North American consumption.



Motor oils account for 45% of the North American lubricant market, with passenger car motor oils the largest individual product segment. The industrial sector is just over one third of North American demand and encompasses a very broad range of products and product segments.

The other transport lubricants segment is quite diverse, with products including transmission and gear oils, marine lubricants, specialized aviation oils, and other products. Each of these segments has stringent performance and quality requirements to ensure that the transportation equipment they lubricate performs well throughout its lifetime. While some product segments require routine maintenance and replacement, more and more products are moving to “fill-for-life” applications, which require higher-quality lubricants that meet performance requirements over many years in service.



The industrial and process sector is extremely diverse, with a broad range of products. The lubricants used in manufacturing, including metalworking fluids, machine tool lubricants, and much of the hydraulic oil and gear oil markets, are critical to successful and profitable plant operations. Other Industrial lubricants, such as compressor oils, industrial engine oils, turbine oils, and transformer oils, are critical to the energy supply system that enables industry and commerce to function. These specialized products, which are often developed in close cooperation with equipment manufacturers and users, illustrate the technical sophistication of today’s lubricant industry.

Lubricant industry structure

The lubricant industry includes a very broad range of companies and industrial/commercial activities. Base oils are produced in approximately 160 petroleum refineries operated by roughly 90 companies, with approximately 20 new facilities currently under construction globally. However, the industry is somewhat concentrated, with only seven companies accounting for over 40% of North American base oil capacity. Base oil plants are located worldwide, but the United States and China account for almost 40% of the total number of base oil facilities worldwide. There is significant international trade in base oils, and many suppliers serve customers worldwide. In addition to the base oil producers, additive companies and other chemical producers provide raw materials and components that are critical to the performance of finished lubricants.

The lubricant blending industry is much more diverse than the base oil manufacturing industry. There are over 900 blending plants globally, with 100 in North America operated by 50 different companies. About 70% of the capacity and plant count in North America is in the United States, with Mexico accounting for 20% and Canada 10%.

Several different integration models are present in the lubricant industry. Some of the largest lubricant marketers have integrated base oil production and operate in an integrated fashion throughout the value chain. However, a number of large base oil producers do not participate in finished lubricant blending, and several of the larger lubricant blending/marketing companies do not have integrated base oil production. Some companies have extensive marketing and sales organizations, while others rely on independent distribution companies for finished product marketing.

To succeed in the lubricant blending and marketing business, players generally rely on a combination of technical expertise, production and supply chain efficiency, marketing strengths, customer service, and distribution efficiency. The mix of competencies differs widely across companies depending on the markets they serve and the strategies they have chosen. The wide variety of customers and product segments within the industry creates opportunities for successful companies both small and large. While some segments such as the passenger car motor oil segment benefit from mass marketing, other segments such as industrial specialties benefit from a much higher level of customer service and attention to customer needs that a focused independent producer can provide. Thus, the lubricant market contains companies with North American lubricant market shares of 15% and more, and many more companies whose lubricant market shares are well under 1%.

The Independent Lubricant Manufacturers Association (ILMA)

Founded in 1948, ILMA counts among its membership various segments of the lubricant market, including manufacturers, distributors, and suppliers. This study specifically focuses on the contribution of the ILMA-manufacturing eligible portion of the lubricant manufacturing industry to the North American economy. ILMA's criteria for manufacturing company membership are as follows:

Manufacturing member companies include any firm, partnership, corporation or other organization which:

- Derives at least 50% of net sales from manufacturing (compounding and blending) lubricants, AND
- Is not owned in any amount or percentage by an entity which produces lubricant base stocks for resale by refining, re-refining, reprocessing, recycling, or otherwise reclaiming used oil; AND
- Is not owned in any amount or percentage by an entity considered to be either a major oil or chemical company with a national or international scope.

This definition of the ILMA-manufacturing eligible segment thus limits membership to companies with a strong business focus on lubricant manufacturing and excludes major oil and chemical companies. Based on this definition of the ILMA-manufacturing eligible company population, IHS Markit has estimated the overall market shares by volume attributable to these companies in North America as follows:

Summary of the ILMA Sector's volume share of the North American lubricant market, 2018

(millions of US dollars)

	Transport	Metalworking fluids	Other industrial	Total
Total market volumes	5,873	510	2,605	8,988
United States	4,920	463	2,207	7,591
Canada	408	34	234	676
Mexico	545	13	164	722
ILMA members' volumes	914	363	1,155	2,432
United States	712	343	979	2,034
Canada	30	11	45	86
Mexico	172	9	131	312
ILMA members' volume shares	15.6%	71.3%	44.3%	27.1%
United States	14.5%	74.1%	44.4%	26.8%
Canada	7.4%	31.3%	19.3%	12.7%
Mexico	31.4%	74.7%	79.9%	43.2%

Source: IHS Markit

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Many of the ILMA-manufacturing eligible companies have a business focus on specialty industrial lubricants, particularly metalworking fluids. IHS Markit estimates that the ILMA-manufacturing eligible population manufactures over 40% of the total North American industrial segment lubricants, with the share of the metalworking fluid market exceeding 70%. ILMA claims the ILMA Sector companies produce over one quarter of automotive lubricants, which includes products that are toll-blended for non-ILMA marketers. IHS Markit believes this is consistent with the 15.6% share of the broader transport lubricants shown in the table above, which does not include products toll-blended for non-ILMA Sector companies.

In terms of sales revenues, IHS Markit estimates the market for lubricants in North America was approximately \$23.5 billion in 2018. Of this, ILMA-manufacturing eligible companies captured \$6.7 billion, or 28.3%, of the North American lubricants revenues. The bulk was from sales in the United States, which amounted to \$5.8 billion. ILMA sales activity in Canada and Mexico was \$482 million and \$382 million, respectively.

Summary of the ILMA Sector's revenue split of the North American lubricant market, 2018

(millions of US dollars)

	Transport	Metalworking fluids	Other industrial	Total
Total market revenues (\$M)	2,055	1,372	3,226	6,653
United States	1,680	1,281	2,828	5,790
Canada	153	77	252	482
Mexico	222	14	146	382

Source: IHS Markit

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ILMA's manufacturing member companies are remarkably diverse, and it is not possible to describe the "typical" ILMA manufacturing member. They range from large, publicly traded international blender/marketers to small, family-owned businesses focusing on a narrow range of niche products. The member companies range in age from several decades or younger to well over a century. However, a common attribute across many manufacturing members is a focus on application of their technical expertise to unique lubrication challenges, whether in specific automotive applications or advanced manufacturing operations. Their smaller size and in-depth knowledge of lubrication science allows them to offer a high level of technical and commercial support to their customers. Many members work with both academic institutions and industry to provide technical training and internship programs. ILMA members are deeply tied to their communities, both economically and socially, contributing to those communities through support of many different charitable programs.

Economic contribution of ILMA in North America

An economic contribution analysis quantifies how specific economic activity catalyzes multiple rounds of contributions to key metrics such as sales, employment, wages, and gross domestic product. For this study, IHS Markit developed a customized model to trace how streams of economic activity initiated by ILMA-manufacturing eligible companies stimulated three levels of economic contribution throughout the US, Canadian, and Mexican economies during 2018. The first level, designated as **direct contributions**, encompasses the economic contributions resulting from ILMA members' selling of their products in the US, Canadian, or Mexican markets (both within their domestic markets and across borders). The second level, **indirect contributions**, captures the follow-on effects that rippled through the multiple tiers of ILMA members' extended supply chains (i.e., suppliers' suppliers, etc.). Finally, the third level, **induced contributions**, covers the economic contributions due to the consumer activity of people who work for either ILMA-manufacturing eligible companies or businesses within the extended supply chains.

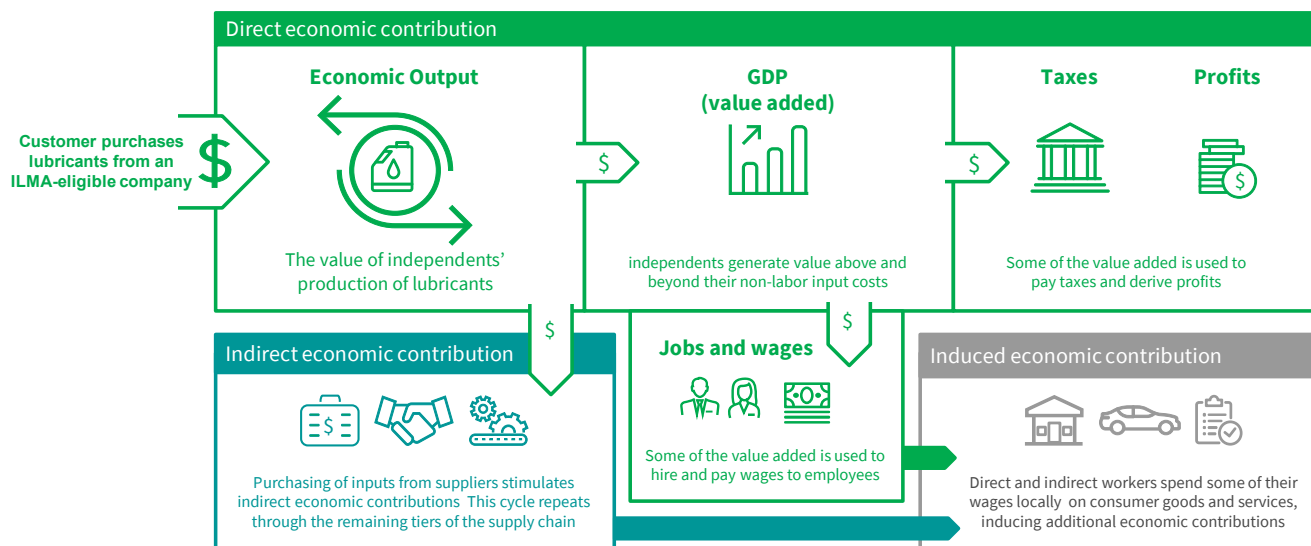
The direct, indirect, and induced contributions are reported for the following economic indicators:

- **Employment.** In order to produce their goods and services, companies must hire and retain employees. This indicator measures the number of workers required to support a given level of sales activity within an economy.
- **Sales activity (output).** In the context of an economic contribution analysis, output represents the value of sales that occurs in the economies studied that are ultimately attributable to transactions initiated by ILMA-manufacturing eligible companies.
- **Value added contribution to gross domestic product/gross state product.** Value added is the difference between the revenue received for a product or service and its non-labor input costs. Gross domestic product (GDP) is the sum of the value added across a national economy.
- **Labor income.** A subcomponent of value added, labor income captures the compensation paid to workers.

The following flow diagram presents the process by which the three economic contribution cycles (direct, indirect, and induced) affect the key economic contribution metrics (employment, sales activity, GDP contribution, labor income). The catalyst event occurs when customers purchase lubricants from ILMA-manufacturing eligible companies (the arrow at the upper left portion of the graphic). At this point, an exchange of money (from customer to ILMA member) is made for product (from ILMA member to customer). IHS Markit estimates that, in 2018, these exchanges totaled \$5.8 billion in the United States, \$481.9 million in Canada, and \$382.0 billion in Mexico.

These transactions initiate the “Direct economic contribution” cycle (shown in the green boxes in the following graphic), beginning in the “Economic output” box. These sales then enable ILMA members to do two primary things.

- First, they buy the non-labor inputs (also known as intermediate purchases) needed to produce the lubricants from their supply network. This initiates the “Indirect economic contribution” cycle, which will be discussed later.
- Second, they generate what economists call “value added” (the “GDP” box below). For the purposes of this analysis, value added is the difference between the value of the sales transactions and the intermediate purchases.



Value added, in turn, can be considered as a pool of funds that ILMA members use for three primary purposes:

- Hire, retain, and pay their work forces;
- Pay federal, state, and local taxes; and
- Draw gross profits.

After the value added is distributed to workers or tax agents or an ILMA member’s gross profits, the direct economic contribution cycle ends.

As previously mentioned, ILMA members make intermediate purchases from their supply network. With these intermediate purchases, the “Indirect economic contribution” cycle commences. The transactions between ILMA members and their suppliers (which, for this discussion, we will designate as “tier 1 suppliers”) initiates a process analogous to the direct economic contribution cycle. The tier 1 suppliers receive money from ILMA members, which they use to make their intermediate purchases, compensate their workers, pay their taxes and derive their profits. The tier 1 suppliers make intermediate purchases from *their* suppliers (tier 2), who then make intermediate purchases from *their* suppliers (tier 3), etc. In other words, the indirect economic contribution cycle represents a multi-tiered cycle of transaction throughout an extended supply network.

The ILMA members and the companies in the extended supply network pay their employees, who then spend a large portion of their wages (on food, consumer goods, healthcare, education, housing, etc.) in their local economies. These sales transactions launch the “Induced economic contribution” cycle. The induced economic cycle is similar to the indirect economic contribution cycle in that it is multi-tiered. The main difference is the induced spending activity tends to center on consumer activity.

IHS Markit developed an integrated model that traced how the sales transactions between ILMA-manufacturing eligible companies and their customers generate economic contributions in the United States, Canada, and Mexico (Appendix A provides more detail on the model). The following table summarizes the direct, indirect, and induced economic contributions made to sales, GDP, labor income, and employment. In North America, these contributions amounted to \$14.4 billion of sales activity, \$7.2 billion of GDP, and 26,000 jobs that paid a total of \$2.7 billion in labor income in 2018.

Summary of the ILMA Sector's economic contributions to the North American economy, 2018

(millions of USD and number of workers)

	Sales activity	Contribution to GDP	Labor income	Employment
United States	\$12,915.1	\$6,521.5	\$2,447.9	22,824
Direct	\$5,789.5	\$3,010.0	\$903.9	3,493
Indirect	\$5,706.7	\$2,719.8	\$1,129.7	12,564
Induced	\$1,418.9	\$791.6	\$414.3	6,767
Canada	\$865.3	\$416.5	\$145.9	1,797
Direct	\$481.9	\$236.1	\$63.6	443
Indirect	\$309.8	\$141.8	\$63.6	971
Induced	\$73.6	\$38.6	\$18.7	384
Mexico	\$618.4	\$271.9	\$63.4	1,680
Direct	\$382.0	\$152.8	\$39.0	326
Indirect	\$208.6	\$102.0	\$20.1	1,065
Induced	\$27.7	\$17.1	\$4.3	289
North America	\$14,398.8	\$7,209.9	\$2,657.2	26,301
Direct	\$6,653.5	\$3,399.0	\$1,006.5	4,262
Indirect	\$6,225.1	\$2,963.6	\$1,213.4	14,599
Induced	\$1,520.3	\$847.3	\$437.3	7,439

Source: IHS Markit

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Economic contributions can also be expressed in terms of multiplier effects. Presenting economic contributions in this manner highlights how one unit of direct contribution is leveraged into follow-on indirect and induced activity. Referring to the United States section of the table below, one dollar of direct sales activity drives almost another dollar of indirect (supply chain) activity and another 25 cents of induced activity. A similar pattern occurs for the contribution to GDP.

A key takeaway from the multiplier analysis is for every direct ILMA worker in the United States, another 5.5 jobs (3.6 indirect and 1.9 induced) are supported. At first glance, the labor income and employment multipliers appear to show different patterns than the sales activity multipliers. The labor income and employment multipliers are characterized by stronger indirect and induced multipliers. Perhaps counterintuitively, this is likely an artifact of the direct employment dynamics in the lubricants sector. Process manufacturing sectors typically require fewer employees per unit of output, which is not necessarily the case in the (indirect) supply network. Thus, a lower denominator in the indirect-to-direct ratio will result in a larger number. An analogous situation also occurs in the induced multiplier.

Summary of the ILMA Sector's multiplier effects in North America, 2018

(millions of USD and number of workers)

	Sales activity	Contribution to GDP	Labor Income	Employment
United States	2.24	2.16	2.71	6.5
Direct	1.00	1.00	1.00	1.0
Indirect	0.99	0.90	1.25	3.6
Induced	0.25	0.26	0.46	1.9
Canada	1.79	1.76	2.29	4.1
Direct	1.00	1.00	1.00	1.0
Indirect	0.64	0.60	1.00	2.2
Induced	0.15	0.16	0.29	0.9
Mexico	1.62	1.78	1.63	5.2
Direct	1.00	1.00	1.00	1.0
Indirect	0.55	0.67	0.52	3.3
Induced	0.07	0.11	0.11	0.9
North America	2.17	2.12	2.64	6.1
Direct	1.00	1.00	1.00	1.0
Indirect	0.94	0.87	1.21	3.4
Induced	0.23	0.25	0.43	1.7

Source: IHS Markit

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Comparing multipliers across the three countries also provides useful insights. For example, the United States has higher indirect multipliers than either Canada or Mexico, indicating a more active supply network in the United States.

Additional insights can be derived from examining the leverage effects of \$1 million of direct sales activity on the economies. Referring to the table below, every \$1million of direct sales in the United States results in:

- \$2.23 million of total sales activity,
- \$1.13 million contribution to GDP,
- \$420 thousand in labor income, and
- Approximately 4 jobs supported.

Summary of the economic contributions stimulated by \$1 million of ILMA Sector direct sales

(millions of USD and number of workers)

	Sales Activity	Contribution to GDP	Labor income	Employment
United States	2.23	1.13	0.42	3.9
Direct	1.00	0.52	0.16	0.6
Indirect	0.99	0.47	0.20	2.2
Induced	0.25	0.14	0.07	1.2
Canada	1.79	1.25	1.42	4.0
Direct	1.00	0.49	0.13	0.9
Indirect	0.64	0.60	1.00	2.2
Induced	0.15	0.16	0.29	0.9
Mexico	1.62	0.71	0.17	4.4
Direct	1.00	0.40	0.10	0.9
Indirect	0.55	0.27	0.05	2.8
Induced	0.07	0.04	0.01	0.8
North America	2.16	1.08	0.40	4.0
Direct	1.00	0.51	0.15	0.6
Indirect	0.94	0.45	0.18	2.2
Induced	0.23	0.13	0.07	1.1

Source: IHS Markit

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Focus on the metalworking fluids sector

A core constituency of the ILMA membership serves the metalworking fluids segment of the lubricants market. Metalworking fluids (MWFs) are used to reduce heat and friction and to remove metal particles during industrial machining and grinding operations. MWFs may be complex mixtures of oils, emulsifiers, anti-weld agents, corrosion inhibitors, extreme pressure additives, buffers (alkaline reserve), biocides, and other additives. IHS Markit estimates that ILMA-manufacturing eligible companies sold approximately \$1.4 billion of metalworking fluid in North America during 2018. Analyzing this sales activity in the economic contribution model yielded the results summarized in the table below. ILMA members engaged in the metalworking fluids segment help generate a total of over \$3.0 billion of sales activity and support more than 4,100 jobs across North America in 2018, with most of the impacts occurring in the United States (over \$2.9 billion in sales activity and nearly 3,900 jobs).

Summary of the economic contributions stimulated by the ILMA Sector's metalworking fluids segment
(millions of USD and number of workers)

	Sales activity	Contribution to GDP	Labor income	Employment
United States	\$2,857.4	\$1,759.4	\$412.9	3,850
Direct	\$1,280.9	\$812.1	\$152.5	589
Indirect	\$1,262.6	\$733.8	\$190.5	2,119
Induced	\$313.9	\$213.6	\$69.9	1,141
Canada	\$138.9	\$82.3	\$18.2	224
Direct	\$77.4	\$46.7	\$7.9	55
Indirect	\$49.7	\$28.0	\$7.9	121
Induced	\$11.8	\$7.6	\$2.3	48
Mexico	\$21.9	\$11.8	\$1.9	51
Direct	\$13.6	\$6.6	\$1.2	10
Indirect	\$7.4	\$4.4	\$0.6	32
Induced	\$1.0	\$0.7	\$0.1	9
North America	\$3,018.2	\$1,853.6	\$433.0	4,125
Direct	\$1,371.8	\$865.4	\$161.6	654
Indirect	\$1,319.7	\$766.2	\$199.1	2,272
Induced	\$326.7	\$221.9	\$72.3	1,198

Source: IHS Markit

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At face value, the MWF market segment accounts for a very small piece of the North American economy. However, a significant amount of North American industrial output is dependent upon the use of MWFs in a wide range of manufacturing processes. Metalworking fluids are primarily used in four manufacturing segments: primary metals, fabricated metals, machinery, and transportation equipment. IHS Markit analyzed the contributions these segments make to North American GDP and determined that they collectively account for about \$948.2 billion of GDP. This represents about 4.0% of North American GDP. So, though the MWF market segment is small, it plays a vital supporting role in about 4.0% of the North American economy.

Contribution to North American GDP made by metalworking fluid-using industries
(billions of US dollars and percentage)

Country	MWF-using industries	Total GDP	Percent
United States	803.6	20,580.2	3.9%
Canada	68.7	1,715.8	4.0%
Mexico	75.9	1,221.4	6.2%
Total	948.2	23,517.5	4.0%

Source: IHS Markit

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Appendix A: Economic contribution model specifications

IHS Markit quantified the economic contribution of ILMA-manufacturing eligible companies in North America using standard input-output (IO) analysis techniques.¹ IHS Markit built an international IO model using data from the World Input-Output Database (WIOD) Project, which was funded by the European Commission as part of the 7th Framework Programme, Theme 8: Socio-Economic Sciences and Humanities. The WIOD Project developed a set of harmonized country-level supply and use tables, which were then integrated with data on international trade to create intercountry (world) input-output tables. The WIOD data was supplemented with employment and wage data from IHS Markit's proprietary Comparative Industry Service (CIS) and World Economic Service (WES).

At its core, an input-output table is a two-dimensional matrix that traces the extent to which a given industry: (a) relies on other industries for supplies; and (b) serves as a supplier to downstream industries and final consumers. This structure captures the inter-industry relationships within an economic region. The WIOD World IO tables expand this concept to encompass the economic inter-relationships of 56 industries across 43 countries. This was of importance to this study as IHS Markit needed to capture the domestic and cross-border economic activity between the United States, Canada, and Mexico. For example, building the model using the WIOD data allowed IHS Markit to trace how sales in the United States could stimulate follow-on economic activity in Mexico.

As primary inputs to the models, IHS Markit estimated the direct sales activity of ILMA-manufacturing eligible companies in the United States, Canada, and Mexico. The IO model calculates the downstream economic output resulting from the direct sales activity. The employment and wage data from CIS and WES were then applied to estimate employment and wage effects across each of the three countries.

Industries included in the model

(A) Agriculture, Forestry, and Fishing

This sector includes the activities of growing of crops, raising and breeding of animals, harvesting timber and other plants, raising animals or animal products from a farm or their natural habitats. Subsectors of this industry include:

- A01 Crop and animal production, hunting, and related service activities
- A02 Forestry and logging
- A03 Fishing and aquaculture

(B) Mining and Quarrying

This sector includes the extraction of minerals occurring naturally as solids (coal and ores), liquids (petroleum), or gases (natural gas). Extraction can be achieved by different methods such as underground or surface mining, well operation, seabed mining, etc. This sector also includes supplementary activities aimed at preparing the crude materials for marketing, e.g., crushing, grinding, cleaning, drying, sorting, concentrating ores, liquefaction of natural gas, and agglomeration of solid fuels.

(C) Manufacturing

Manufacturing includes the physical or chemical transformation of raw materials, substances, or components into new products. Substantial alteration, renovation, or reconstruction of goods is also considered to be manufacturing, as well as assembly of the component parts of manufactured products. Subsectors of this industry include:

¹ IO analysis traces back to the seminal work of Harvard economist Wassily Leontief in 1941, when he calculated an IO table of US economy. Leontief ultimately earned the Nobel Prize in Economics in 1973.

- C10-C12 Manufacture of food products, beverages and tobacco products
- C13-C15 Manufacture of textiles, wearing apparel and leather products
- C16 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
- C17 Manufacture of paper and paper products
- C18 Printing and reproduction of recorded media
- C19 Manufacture of coke and refined petroleum products
- C20 Manufacture of chemicals and chemical products
- C21 Manufacture of basic pharmaceutical products and pharmaceutical preparations
- C22 Manufacture of rubber and plastic products
- C23 Manufacture of other non-metallic mineral products
- C24 Manufacture of basic metals
- C25 Manufacture of fabricated metal products, except machinery and equipment
- C26 Manufacture of computer, electronic and optical products
- C27 Manufacture of electrical equipment
- C28 Manufacture of machinery and equipment n.e.c.
- C29 Manufacture of motor vehicles, trailers and semi-trailers
- C30 Manufacture of other transport equipment
- C31_C32 Manufacture of furniture; other manufacturing
- C33 Repair and installation of machinery and equipment

(D) Electricity, Gas, Steam, and Air Conditioning Supply

Electricity, gas, steam, and air conditioning supply includes the operation of electric and gas utilities, which generate, control, and distribute electric power or gas, as well as the provision of steam and air-conditioning supply. This includes the provision of electric power, natural gas, steam, hot water, and the like through a permanent infrastructure (network) of lines, mains, and pipes, as well as the distribution of electricity, gas, steam, hot water, and the like in industrial parks or residential buildings.

(E) Water Supply, Sewerage, Waste Management, and Remediation Activities

Water supply, sewerage, waste management, and remediation activities include activities related to the management (including collection, treatment, and disposal) of various forms of waste, such as solid or non-solid industrial or household waste, as well as treatment and remediation of contaminated sites. Activities of water supply are also grouped in this section, since they are often carried out in connection with, or by units also engaged in, the treatment of sewage. Subsectors of this industry include:

- E36 Water collection, treatment, and supply
- E37-E39 Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities; and other waste management services

(F) Construction

Construction includes general construction and specialized construction activities for buildings and civil engineering works. It includes new work, repair, additions and alterations, the erection of prefabricated buildings or structures on the site, and construction of a temporary nature. General construction is the construction of entire dwellings, office buildings, stores, and other public and utility buildings, farm buildings etc., or the construction of civil engineering works such as motorways, streets, bridges, tunnels, railways, airfields, harbors, and other water projects; irrigation systems; sewerage systems; industrial facilities; pipelines and electric lines; and sports facilities. Also included is the repair of buildings and engineering works, specialized construction activities, the erection of steel structures, building finishing, and building completion activities.

(G) Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles

This sector includes wholesale and retail sale (i.e. sale without transformation) of any type of goods and the rendering of services incidental to the sale of these goods. Also included in this section are the repair of motor vehicles and motorcycles. Sale without transformation is considered to include the usual operations associated with trade, for example sorting, grading, and assembling of goods; mixing (blending) of goods; bottling, packing, breaking bulk, and repacking for distribution in smaller lots; storage, cleaning, and drying of agricultural products; and cutting out of wood fiber boards or metal sheets as secondary activities. Subsectors of this industry include:

- G45 Wholesale and retail trade and repair of motor vehicles and motorcycles
- G46 Wholesale trade, except of motor vehicles and motorcycles
- G47 Retail trade, except of motor vehicles and motorcycles

(H) Transportation and Storage

Transportation and storage includes the provision of passenger or freight transport, whether scheduled or not, by rail, pipeline, road, water, or air and associated activities such as terminal and parking facilities, cargo handling, storage, etc. Included in this section is the renting of transport equipment with driver or operator. Also included are postal and courier activities. Subsectors of this industry include:

- H49 Land transport and transport via pipelines
- H50 Water transport
- H51 Air transport
- H52 Warehousing and support activities for transportation
- H53 Postal and courier activities

(I) Accommodation and Food Service Activities

Accommodation and food service activities include the provision of short-stay accommodation for visitors and other travelers, and the provision of complete meals and drinks fit for immediate consumption.

(J) Information and Communication

Information and communication includes the production and distribution of information and cultural products, the provision of the means to transmit or distribute these products, as well as data or communications, information technology activities, and the processing of data and other information service activities. Subsectors of this industry include:

- J58 Publishing activities
- J59_J60 Motion picture, video and television program production, sound recording and music publishing activities; programming and broadcasting activities
- J61 Telecommunications
- J62_J63 Computer programming, consultancy and related activities; information service activities

(K) Financial and Insurance Activities

Financial and insurance activities include financial service activities, including insurance, reinsurance, and pension funding activities, and activities to support financial services. This sector also includes the activities of holding assets, such as activities of holding companies and the activities of trusts, funds, and similar financial entities. Subsectors of this industry include:

- K64 Financial service activities, except insurance and pension funding
- K65 Insurance, reinsurance, and pension funding, except compulsory social security
- K66 Activities auxiliary to financial services and insurance activities

(L) Real Estate Activities

Real estate activities include acting as lessors, agents, and/or brokers in one or more of the following: selling or buying real estate, renting real estate, providing other real estate services such as appraising real estate or acting as real estate escrow agents. Also included is the building of structures, combined with maintaining ownership or leasing of such structures. This sector includes real estate property managers.

(M) Professional, Scientific and Technical Activities

Professional, scientific, and technical activities require a high degree of training, and make specialized knowledge and skills available to users. Subsectors of this industry include:

- M69_M70 Legal and accounting activities; activities of head offices; management consultancy activities
- M71 Architectural and engineering activities; technical testing and analysis
- M72 Scientific research and development
- M73 Advertising and market research
- M74_M75 Other professional, scientific, and technical activities; veterinary activities

(N) Administrative and Support Service Activities

Administrative and support services activities include a variety of activities that support general business operations. These activities differ from those in professional, scientific, and technical since their primary purpose is not the transfer of specialized knowledge.

(OTU) Public Administration and Defense, Other Services

Public administration and defense, other services includes activities of a governmental nature, normally carried out by the public administration. This includes the enactment and judicial interpretation of laws and their pursuant regulation, as well as the administration of programs based on them, legislative activities, taxation, national defense, public order and safety, immigration services, foreign affairs, and the administration of government programs. This section also includes compulsory social security activities.

Other services includes the activities of households as employers of domestic personnel as well as the activities of international organizations such as the United Nations.

(P) Education

Education includes training at any level or for any profession, oral or written, as well as by radio and television or other means of communication. It includes education by the different institutions in the regular school system at its different levels, as well as adult education, literacy programs, etc. Also included are military schools and academies, prison schools, etc. at their respective levels. The section includes public, as well as private education.

(Q) Human Health and Social Work Activities

Human health and social work activities include the provision of health and social work activities. Activities include a wide range of activities, starting from health care provided by trained medical professionals in hospitals and other facilities, residential care activities that still involve a degree of health care activities to social work activities without any involvement of health care professionals.

(R_S) Arts, Entertainment and Recreation

Arts, Entertainment and Recreation includes a wide range of activities to meet various arts, entertainment, and cultural interests of the general public, including live performances, operation of museum sites, gambling, sports, and recreation activities. Also included are the activities of membership organizations, the repair of computers and personal and household goods, and a variety of personal service activities not covered elsewhere in the classification.

Appendix B. Glossary of economic contribution analysis terminology

Capital expenditure (capex)	This includes the investments made by establishments operating in a sector during a certain year, net of fixed assets sold.
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Corporate income tax	The tax levied on a corporation's income.
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Direct impacts	The first-order responses throughout the economy due to direct sales transactions.
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Economic impact analysis	A study that examines the direct, indirect, and induced impacts of the independent operators' production activities and supply chain spending.
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Employment	Includes wages, salaries, and self-employment jobs within the economy.
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Extended supply chain	The network of suppliers who provide goods and services to the first tier of a supply chain. This is a subset of the indirect economic contributions.
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Fiscal analysis	The estimation of the impacts of tax and non-tax contributions of an entity to the government in which it is currently operating.
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Government revenues	The streams of revenues paid to a government agency.
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Gross domestic product (GDP)	The sum of value added across all products and services produced within an economy. It is also called national output.
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Indirect impacts	The follow-on supply chain or purchasing network activities that are initiated by direct spending.
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Induced impacts	The response of the economy to marginal changes in consumer spending from employees of the direct and indirect businesses.
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Input-output analysis	The analysis utilizes an input-output table that represents an economy and depicts the flows of related economic transactions that take place within an economy. It also shows the economic interconnections that exist between different components of the economic system, i.e. production activities, the government, and supplier enterprises.
Labor income	This captures all forms of employment income, including employee compensation (wages and benefits, employer-paid payroll taxes, unemployment taxes, etc.) and proprietor income (payments received by self-employed individuals and unincorporated businesses).
Operating expenditures (opex)	This captures purchases of inputs and suppliers.
Output	The total value of all goods and services produced within an economy.
Personal income tax	The tax levied on an individual's income.
Value added	The difference between the revenue received for a product or service and its non-labor input costs. It is also understood as the difference between the value of sale and the cost of its required non-labor inputs.

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