As all of us navigate the new normal of the global COVID-19 health crisis, the Metal Powder Industries Federation (MPIF) wants to ensure that you continue to have access to the tools, resources, and most importantly—the community of your powder metallurgy peers. This network can help you do your job better, advance your organization, and advance PM technology through this unprecedented time. These unsettling times are impacting every facet of life.

Cautious optimism tempered the business outlook for the North American PM industry at the start of this year. Based on last September’s annual PM Industry Pulse Survey, conducted among the members of MPIF, the majority of responding companies expected sales to increase in 2020 over 2019, but there was a looming concern that the economy was ripe for a correction.

And of course, at the time, the shocking COVID-19 pandemic damage on manufacturing and the global economy was unthinkable. But, could this global disruption be a wake-up call and trigger a robust movement to re-shore manufacturing? Time will tell.

2019 Business and Technology Trends

When the final numbers were tallied, 2019 metal powder shipments, a bellwether indicator, signaled a continuing negative trend in traditional PM sectors. Total North American metal powder shipments declined by an estimated 11% to 412,973 mt (455,317 st).
### North American Metal Powder Shipments

<table>
<thead>
<tr>
<th></th>
<th>2018 Short Tons</th>
<th>2018 Metric Tons</th>
<th>2019 Short Tons</th>
<th>2019 Metric Tons</th>
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<tbody>
<tr>
<td>Iron &amp; Steel</td>
<td>433,203</td>
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<td>744</td>
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<td>Tungsten</td>
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<td>1,587</td>
<td>1,689</td>
<td>1,532</td>
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<tr>
<td>Tungsten Carbide</td>
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<td>7,919</td>
<td>7,183</td>
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<tr>
<td>Nickel</td>
<td>6,100</td>
<td>5,533</td>
<td>5,500</td>
<td>4,989</td>
</tr>
</tbody>
</table>

*(E) estimate  (R) revised  511,373  463,815  455,317  412,973

1 st = 0.907 mt

Iron powder shipments decreased 10.4% to 352,234 mt (388,351 st). PM and friction-grade powder shipments were down as well by 10.4% to 320,257 mt (353,095 st). Welding applications dropped by 13.3% to 13,735 mt (15,143 st). Cutting, scarfing and lancing applications declined by 14% to 871 mt (960 st). Miscellaneous uses declined 6.4% to 17,372 mt (19,153 st).
Stainless steel, copper and nickel powder shipments all declined by an estimated 9 to 10%. Stainless powders decreased to 7,220 mt (7,960 st); copper and copper base powder shipments to 15,328 mt (16,900 st), and nickel powder to 4,989 mt (5,500 st).

Aluminum powder shipments declined more than 21% to an estimated 23,988 mt (26,448 st). Molybdenum shipments declined an estimated 32.9% to 499 mt (550 st). Tungsten powder shipments decreased by an estimated 3.5% to 1,532 mt (1,689 st), and tungsten carbide powder shipments decreased an estimated 7.8% to 7,183 mt (7,919 st).

Vehicle production is a crucial element of the North American economy. Like many other manufacturing segments, vehicle production has slumped in the past three years due to increased costs of production, changes in supply chains, but primarily consumer needs. In 2016, manufacturers in North America produced a record 18 million passenger vehicles. In 2019, around 16.8 million vehicles were produced in North America. Of those vehicles, roughly 10.9 million were assembled in the United States, with Mexico and Canada assembling around six million between them.

Vehicle sales declined 1.3% to 17,047,725 vehicles in 2019. While automotive applications account for about 75% of traditional PM parts production, there seems to be a disconnect between the sharp drop in iron powder shipments for parts vs. robust vehicle production and sales.

Several thoughts come to mind, including the growth of hybrids and electric vehicles, but the downsizing of engines and transmissions and a fading market for traditional sedans are the obvious culprits. Sedans, which make up about 28% of the North American sales, are predominantly available only from transplanted Asian and European manufacturers. Designers in these regions have been less “PM friendly” and hesitant to adopt and utilize PM in their designs. It has been estimated that less than 30% of the global passenger vehicles’ connecting rods are powder forged. Powder-forged connecting rods have been proven to outperform connecting rods produced by other technologies. The powder-forged connecting rod continues to be an opportunity for the PM industry and should be considered for hybrid passenger vehicles.

Additionally, the greater acceptance of turbochargers to increase engine efficiency, including fuel economy, torque, and horsepower, has assisted in reducing engine sizes from 8 to 6 to 4-cylinders resulting in fewer connecting rods and main bearing caps per vehicle along with smaller transmission carriers. For example, 5 and 6-speed transmissions are being replaced by 8 and 9-speed designs that use smaller parts, which are more open to less costly castings and
stampings. Many turbocharged 4-cylinder engines, and 3 and 4-cylinder hybrid engines, are designed in Asia and Europe without powder-forged connecting rods and PM main bearing caps.

As you can imagine, this has caused great concern for the North American PM industry. MPIF has initiated what I believe to be the deepest dive to date to estimate the total PM in a North American passenger vehicle.

It is a difficult task to provide one, all-inclusive weight as there are numerous variables such as the platform: pickup, large SUV, crossover, sedan; the make and design: North American, Asian, or European; engine type: internal combustion, hybrid electric, electric; or drivetrain: all-wheel, front-wheel, rear-wheel, and 4-wheel drive.

In 2019, it was reported that the estimated average PM weight in a 2018 North American passenger vehicle was 19.5 kg (43 lb). This was based on robust pickup truck and large SUV sales with 8-cylinder engines and 4-wheel drive that likely skewed the estimated average as calculated.

In short, the estimate for 2018 was slightly overstated. After thorough review, the estimated average weight in a 2019 North American passenger vehicle was 17.7 kg (39 lb), a decline of 9.3%. Many industry experts project the PM weight in passenger vehicles will decrease 1–2% annually without new applications or a greater acceptance of powder-forged connecting rods and PM main bearing caps in hybrid engines.

**Metal Injection Molding and Additive Manufacturing**

In contrast to the press & sintering community, metal injection molding (MIM) and metal additive manufacturing (metal AM) gained in 2019.

Sales of MIM parts in the U.S. increased by an estimated 5% to a range of $460 to $480 million in 2019. It is estimated that MIM-grade powders, less than 20 micrometres, consumed in the U.S., domestically produced and imported, increased by 5% in 2019 to 3,637,627 kg (8,020,968 lb). This amount also includes MIM-grade fine powders for metal AM applications.

Interest in metal AM as a complement to MIM parts manufacturing is growing. More than 10 Metal Injection Molding Association (MIMA) member companies reported that they anticipate purchasing metal AM production machines within the next two years, with the binder-jet process leading the way. Initially, MIM parts makers expect to use metal AM to print prototype
designs to avoid the need for costly tooling. Additionally, others will use metal AM to build tooling to reduce the time from part design to part production.

MIM end markets remained stable in 2019, dominated by firearms and medical applications.

![MIM Market Mix According to Weight of Parts Shipped](image)

**Refractory Metals**

The refractory metals market in 2019 was mostly flat to down. Imports of lower-cost tungsten carbide powders were up significantly, which negatively impacted North American powder shipments.

In addition to lower-cost imports, the tungsten and tungsten carbide markets were down in 2019 due to: a devastated oil and gas market; decreased global mining; and a decrease in demand for tungsten carbide cutting tools due to a reduction in manufacturing during the second half of the year. North American oil and gas rig counts were near the lowest levels since recordkeeping started in 1949. Global mining activity, which drives demand for tungsten and tungsten carbide, also remained at less than normal levels. Mining is very dependent on global economies in North America, Asia, and Europe, with those economies performing from expanding to flat to negative, respectively. One positive highlight was U.S. defense demands remained strong throughout 2019.

It should be noted, in 2018, considerable molybdenum powder production moved offshore, negatively affecting shipments of powder produced in North America. After further analysis, a
restatement of the 2018 molybdenum shipments is required. New estimates for 2018 reflect a reduction from 856 mt (944 st) to 744 mt (820 st), a decrease of 34% in shipments compared with 2017, which had 1,125 mt (1,240 st). In 2019, North American molybdenum powder demand was estimated to be down by 50–55%.

2020 Trends

20/20 is considered to be perfect vision, but the year 2020 outlook is quite obscure. We can view the current state of the PM industry through short-term, fear-tinted glasses or gain a clearer picture of long-range opportunities. Just like U.S. manufacturing in general, the PM industry has been impacted negatively by the pandemic.

Many economists forecast a gradual “U” or “W” recovery resulting in a North American recession that will limit new housing builds and automotive production. The U.S. has witnessed high unemployment rates nearing the level of the Great Depression. Elk County, Pennsylvania, for example, where the PM industry’s hub St. Marys is located, approached 26% unemployment earlier this year, the highest unemployment rate per capita in Pennsylvania. These economic events, unprecedented in modern times, are testing the public consumer and corporations alike.

Cautionary signs seeded the new year with companies forecasting a range of options: low single-digit gains, flat sales, or modest declines in the first quarter. January and February iron powder shipments for PM applications decreased by 5%, before a 19.2% year-over-year plunge in March, a foreshadow of the COVID-19 pandemic. Copper powder and stainless steel forecasts remained flat just before the pandemic storm mutated into a deadly hurricane in April devastating the entire domestic and global economies.

In many areas across the U.S., manufacturing companies were deemed “non-essential businesses” and forced to close their operations to adhere to local government regulations. Companies that had less than 500 employees were eligible for government programs, such as the Payment Protection Program, but many were forced to furlough or lay-off employees.

As signs of the pandemic subsided, shuttered since March, the North American automotive industry resumed production in mid-May. New safety policies, self-distancing protocol, and a disrupted supply chain posed more challenges than expected resulting in the month ending in serious negative territory. Some U.S. factories explored alternative suppliers to compensate for plants that remained closed or were overwhelmed by orders for parts in high demand. General Motors for example, reportedly delayed plans to increase production of pickup trucks in May
because of a shortage of parts from Mexico. Many manufacturing plants in Mexico, which surpassed China as the top trading partner to the U.S. last year, were ordered closed early during the pandemic.

Overall, the second quarter appears to be a lost cause for most of manufacturing, including PM companies.

However, on a positive note, U.S. jobs increased by 2.5 million in May, by far the biggest one-month jobs gain since at least the Great Depression. This gain decreased unemployment to 13.3%, far better than the 19.5% economists had projected.

PM equipment suppliers hunkered down as well. A veteran toolmaker reports PM tooling builds are down as much as 75%. Some press and furnace suppliers reported providing start-up services to their customers as most equipment had not been in operation for nearly 2 months.

Traditional PM parts makers are hanging on in a survival mode, especially those connected to automotive OEMs. However, the smaller family-owned shops that are more diversified seem to be doing better.

HVAC manufacturers are still ordering furnaces and air conditioners, along with agricultural, lawn & garden, and medical equipment customers for parts going into hospital beds and wheelchairs. Gym equipment for home use continues to expand and could be an interesting new market for conventional PM due to shelter-in-place orders.

One family-owned company executive reports some customers have moved up ordering to build up inventories for the future. As a result, he sees June orders rebounding somewhat. He is also making lemonade from the lemons he is dealing with by investigating process improvements, such as reducing scrap. In another facility, company engineers are devoting time to installing and qualifying new robots connected to compacting presses, furnaces, and machining centers. Automation will continue to be utilized industrywide.

Another family-owned facility recently experienced a surge in new, mostly non-automotive parts. They also reported an increase in former customers investigating the option of reshoring parts that were lost to low-cost suppliers over the past decade.

MIM and metal AM markets have a brighter outlook in 2020. The firearms and medical markets will dominate MIM production again. Firearms sales, for both handguns and long guns, are expected to be robust in response to recent social injustices and this Fall’s presidential election.
Medical and dental shipments could suffer a slight downturn as elective medical/dental procedures were prohibited due to state lockdowns. At best, MIM parts sales may increase by single digits or stay even with last year.

Metal AM continues to be on a roll, especially for aerospace and medical applications such as custom implants that replace forgings. Some common metal AM materials include nickel-cobalt alloys, aluminum-silicon-magnesium alloys, low-alloy steel, stainless steel and Inconel.

Without a doubt, the global automotive market is changing. Long standing PM champions face a shrinking universe of opportunities.

While the Detroit 3, General Motors Corporation, Ford Motor Company, and Fiat Chrysler Automobiles, restarted production in mid-May, forecasts for light vehicle sales and production still look gloomy. Who would have thought that we would be offered incentives to purchase vehicles that included no interest for 84 months, no down payment, and 120 days before the first payment? During the midst of the shutdown, IHS Markit forecasted a 26.7% sales collapse in North America directly related to the pandemic. The result is the U.S. auto market sales dropping to 12.5 million units and production declining to 12.2 million units.

We need to keep an eye on this as we are nearing record levels of unemployment that will also negatively affect automotive sales.

Commencing on July 1, 2020, new rules will govern how vehicles are produced as a result of the United States–Mexico–Canada Agreement, or USMCA, that will include that rules of origin are to be met on automobiles, specifically that 75% of the finished vehicles’ value is to come from within the USMCA governed region: an increase of 12.5% from the previous North American Free Trade Agreement, or NAFTA.

This could be a great opportunity for re-shoring parts and assemblies.

Positive results will be obtained from more value-added parts assemblies and providing more families of parts. Opportunities still exist for new PM designs outside of engines and transmissions. There could be a new metric rising besides focusing on pounds per vehicles based on large parts. Are there opportunities in smaller more highly engineered PM parts in non-drivetrain systems? Have we begun to tap the hybrid vehicle and electric vehicle markets? Low gasoline prices will delay the move from larger to smaller engines, but gaining acceptance of PM in 3- and 4-cylinder hybrid vehicles should be a primary focus.
And what about the millennials?

Will they continue to choose ride-share services, rental cars, bicycles, and electric scooters over car ownership? Many news reports suggest that the COVID-19 pandemic has changed the minds of many millennials who will prefer their own automobile and house over the risk of cross-contamination and recirculating air in apartments and condominiums.

The PM industry has a strong technology base, built on the interaction of manufacturers, academia, and research organizations. As a maturing industry, we must not let this diminish as every industry needs to continue to evolve or it will simply die. Investments in R&D for new materials, equipment advancements, and process refinement will need to remain strong.

Metal powder producers are actively working on high-performance materials. For example, one powder producer is focusing on a specialized material with high-apparent density to improve die-filling for thin-walled parts and faster production rates. Another powder producer is launching stearate-free lubricants for medium to high-density compaction. A third powder producer is focusing on advanced machinability additives to improve tool life and productivity by reducing machining cycle-time.

Compacting press and sintering furnace suppliers are also dedicated to improvements. Some advancements include faster tool exchange systems, electric presses for high-production manufacturing of smaller PM parts, and implementation of robots. Sintering improvements include a new approach to remove lubricants from green compacts thoroughly prior to sintering and reducing energy expenses by up to 80%.

Metal AM could become a significant growth market for aluminum powders as customers explore the light metal’s environmental and lightweight benefits. Metal AM trends in the next decade will focus on enhancing throughput, printing larger parts, multi-material printing, and repairing and refurbishing expensive parts and tooling.

There continues to be tremendous activity in the metal AM sector. From one manufacturer concentrating on making large parts, up to 450 kg (992 lb), for the aerospace and defense industries, to another developing binder-jet printing of tungsten heavy alloys and the directed energy deposition of molybdenum, there are a lot of opportunities for this exciting sector. In addition, advances continue for metal AM processes such as binder jetting, material extrusion, and material jetting, all of which are de-bound and sintered, leveraging the successes of the MIM technology.
We continue to see new applications for metal powders. Universities from Canada to the Netherlands are researching metal powders as a sustainable energy source. It is easy to transport and recycle. For example, if you combust iron powder with hot gases to drive an engine, the result is rust. Extracting the oxygen from the rust particles using hydrogen produced from electricity surpluses from sustainable sources can turn it into iron powder again. Other applications include water purification. Not only is this of great benefit to community water sources, but it is also a humanitarian effort for developing countries that need to remove multiple contaminants from groundwater and drinking water in a single step. These are just a couple of examples of how metal powders and powder metallurgy will continue to evolve.

MPIF, the Center for Powder Metallurgy Technology (CPMT), and the National Science Foundation (NSF) have been champions of advancing the PM technology through educational outreach. Over the past 3 years, over 150 engineering students have been awarded full-conference grants, including lodging, through the efforts of these organizations. The grants provide the opportunity for the PM industry to showcase the technology to some of the brightest young minds that will someday hopefully select PM as their metal-working solution. NSF has already extended the 2020 conference grants to be awarded in 2021, as they were not used due to the cancellation of the Montreal conferences.

There will always be a need to advance the technology through education. Earlier this Spring, after cancelling the Montreal conferences, we launched the complimentary MPIF Webinar Series as a member benefit for our MPIF and APMI members. This has been extremely well received by the members and has also reinforced why membership is important. If you are not an MPIF or APMI member, you should consider joining so that you have access to these important educational offerings.

For the first time in its 56-year history, the Basic Powder Metallurgy Short Course will be held virtually as a result of the ongoing pandemic. The Basic PM Short Course brings over a dozen of our industry experts together for a thorough review of numerous PM processes, including conventional press & sinter, MIM, AM, and refractory metals. Later this year we will also offer our PM Sintering Seminar virtually. These are great opportunities for individuals to take advantage of attending the Basic PM Short Course and Sintering Seminar, while saving travel & lodging expenses, enjoy reduced registration fees, and no time away from their facilities.

The one certainty for 2020 is uncertainty. The future is bright for manufacturing adaptation and the PM industry. Despite armies of naysayers from every political persuasion, positive signs are flashing on the horizon for U.S. manufacturing. Ugly short-term tremors cannot define us. Fortunately, throughout its history, the PM industry has survived the ups and downs of the
macro economy. The industry is well-prepared for whatever comes our way and well-equipped to shape the future. We will improve the technology through R&D, education, and cooperative efforts, while adapting our resources to ensure we can respond in an agile manner to forces beyond our control, such as the COVID-19 pandemic.

The entrepreneurial spirit embedded in PM’s DNA is still alive. Opportunities are waiting to demonstrate PM’s problem-solving advantages for now and the future.

It is unfortunate that we were unable to gather in Montreal this year, but MPIF looks forward to hosting you at PowderMet2021 and AMPM2021, June 20-23, 2021, in Orlando. We anticipate an exceptional event and look forward to you spending time with us.

# # #

Editor’s note: Digital copy available. Contact Dora Schember at 609-452-7700 / dschember@mpif.org

About the Metal Powder Industries Federation
Metal Powder Industries Federation is the North American trade association formed by the powder metallurgy industry to advance the interests of the metal powder producing and consuming industries and provides a single point of reference for all MPIF member companies.

About APMI International
APMI International is a non-profit professional society which promotes the advancement of powder metallurgy and particulate materials as a science. Its purpose is to disseminate and exchange information about PM and particulate materials through publications, conferences, and other activities of the society.

About the Center for Powder Metallurgy Technology
The Center for Powder Metallurgy Technology merges the academic and corporate powder metallurgy worlds together with a joint goal to promote PM industry progress. This progress depends on the business community and its drive for profit, and it also takes the educational community with its dedication to research and the pursuit of knowledge.