

2021
MONTANA
MANUFACTURING
REPORT



ACKNOWLEDGMENTS

This report was prepared by the Montana State University Montana Manufacturing Extension Center and the Bureau of Business and Economic Research (BBER) at the University of Montana under award 70NANB16H210 from the National Institute of Standards and Technology Manufacturing Extension Partnership, U.S. Department of Commerce. The statements, conclusions and recommendations are those of the author and do not necessarily reflect the views of the National Institute of Standards & Technology Manufacturing Extension Partnership or the U.S. Department of Commerce. The author is Robert Sonora and BBER's project manager John Baldrige directed the survey. Brenna Swinger, a BBER summer intern, and BBER economist Derek Sheehan provided able data assistance. BBER would like to acknowledge the assistance of Jenni West and Paddy Fleming from MMEC. All errors or omissions are our own.



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EXECUTIVE SUMMARY

This report is on the state of Montana manufacturing conducted for the Montana Manufacturing Extension Center (MMEC). The report and analysis was done by the Bureau of Business and Economic Research (BBER) at the University of Montana. This is the 25th year that BBER and MMEC have collaborated to produce reports on Montana's manufacturing climate. The three primary topics are: the state of manufacturing at the state and national level in a general economic context; a survey of Montana manufacturers about the state of Montana manufacturing; and an impact survey of firms which used MMEC's consulting services.

STATE OF MONTANA MANUFACTURING

Montana's manufacturers face different challenges than the nation as a whole because the composition of manufacturing production is different and is primarily concentrated in nondurable production – the Bureau of Economic Analysis defines nondurable goods as goods that have an average life of less than three years. The two largest manufacturing sectors in Montana, petroleum and coal, and wood product manufacturing, are not among the seven largest sectors nationally, demonstrating how the Montana manufacturing sector differs substantially from the experience of the country.

Some summary facts about Montana manufacturing in 2020 are:

- Over 3,900 manufacturing firms are in operation in Montana, including sole proprietors;
- Manufacturing accounts for roughly 16% of Montana's economic base;
- Manufacturing jobs paid about \$52,111 in earnings, compared to the state average of \$46,743;
- Accounts for 5.1% of total private state income equaling \$1.1 billion;
- Employs 4.3% of Montana's nonfarm workforce, with about 20,400 employees;
- Produced 6.1% of Montana's output with a value of \$3.1 billion;
- Grew more than double the national average in employment, income and output.

In the aftermath of the 2020 COVID-19 recession, Montana manufacturing bounced back relatively quickly from the deep economic drop in the second quarter of 2020. Last year, we predicted that nondurable manufacturing would return to pre-COVID levels within a year or so. Employment in this sector returned to pre-pandemic levels in early 2021. Durable manufacturing is forecast to return to the long-run trend a year or so later, in line with our predictions from a year ago.

Montana manufacturers are active in global markets as well. The three largest export sectors for Montana in 2020 were: chemicals, machinery and transportation equipment. Food, beverages and tobacco fell out of second place during the pandemic. By far the largest export market is Canada, accounting for almost 30% of Montana's manufactured exports. In 2020, the remaining large export markets were: China (2), South Korea (3), Belgium (4), and Japan (5).

MONTANA MANUFACTURERS SURVEY

This section of the report presents the findings of the 2021 Montana Manufacturers Survey. The initial Montana manufacturers survey was conducted in 1999. Since then, the Bureau of Business and Economic Research at the University of Montana has conducted this survey each year. The purpose of the survey is to learn the manufacturers' assessment of their plant's economic performance in 2020 and their outlook for 2021. This year, the annual Montana man-

Manufacturers survey included a question about the effects of the COVID-19 pandemic.

Manufacturing in Montana is predominantly performed by small businesses. The U.S. Census Bureau reports 1,666 manufacturing firms with employees in Montana, and 51% of Montana manufacturers have five or less employees. There are no manufacturers with 300 or more workers in the state.

Highlights from the 2020 manufacturing survey:

- About one-third of manufacturing firms saw an increase in total sales and profits from 2019;
- Fifty-eight percent of firms did not reduce production capacity;
- A minority of firms (25%) reduced employment;
- Over one-third of Montana's manufacturing firms experienced a significant worker shortage; and
- The primary impacts of the COVID-19 pandemic on manufacturing in 2020 were the inability to find employees and intermediate goods supply either because of shortages or high transportation costs.

EVALUATION OF MONTANA MANUFACTURING EXTENSION CENTER

The Montana Manufacturing Extension Center works with manufacturers to create and retain jobs, innovate, reduce costs, increase profits, and save time and money. MMEC employees typically make on-site visits to manufacturing clients to assess problems, suggest appropriate solutions and assist with implementation. MMEC closely monitors its performance by welcoming feedback and carefully following an evaluation procedure developed by the National Institute of Standards and Technology (NIST) and administered by an independent third party.

The primary NIST survey findings from 2020 are as follows:

- Montana manufacturing clients were very satisfied, with 63% of respondents saying they relied exclusively on MMEC as a business service provider;
- MMEC's net promoter score for 2020 was 87/100.
- Staff expertise was again the most important factor for firms to use MMEC services;
- The most important challenges facing surveyed MMEC clients were ongoing continuous improvement/cost reduction strategies, employee recruitment and retention, and product innovation/development;
- 2020 survey respondents said that working with MMEC resulted in 310 new and retained manufacturing jobs and directly or indirectly added approximately \$2.2 million to Montana individual income tax revenue over the previous 12 months. Since 2000, MMEC visits have resulted in 6,496 created or retained jobs and \$1.35 billion in increased or retained sales;
- The Montana return on investment for MMEC during 2020 was 4.4 to 1; and
- MMEC clients paid approximately \$220 thousand in fees during 2020, yielding a return on investment of about 82 to 1.

THE U.S. AND WORLD ECONOMIES

The United States entered a recession on March 1, 2020. The recession was caused by the need to close the economy as the impacts of the COVID-19 pandemic began to ripple through the global economy. The pandemic brought an end to the longest economic expansion in U.S. post-WWII economic history, lasting 10 1/2 years. COVID-19 and policy responses, both from an economic and health perspective, continue to generate considerable uncertainty. The University of Michigan's index of consumer sentiment remains about 15% below its pre-pandemic level. After a period of optimism associated with declines in new cases and a successful vaccine, the delta variant of the coronavirus could potentially slow the recovery in process.

While economic data for 2020 was strongly negative, the economic recession beginning in February of 2020 was short lived, officially ending in April of 2020. The second quarter of 2020 saw the largest decline in real GDP growth since World War II. However, one year later U.S. growth saw its largest expansion since 1950. U.S. manufacturing industrial production is up 1% from February 2020, U.S. total factory orders are 9% higher, and manufacturing industrial capacity utilization is currently at 76.8% (July 2021), which is above the pre-pandemic level of 75.7%. The ISM manufacturing index remains above 50.

Current forecasts remain bullish on the U.S. economy, with the caveat that many of these forecasts were published before the current spike in delta variant related COVID cases. **Figures 1A-B** show forecasts from the Organization of Economic Co-operation and Development (OECD) for the United States and the world economy as a whole. The most recent forecast is May 2021 and the second forecast is from the OECD's December 2020 report. Most economists have been surprised by the speed of the U.S. economic

recovery. This sentiment is reflected by comparing these two forecasts. If we consider the U.S., the 2021 OECD prediction estimates the economy to be over 6.5% larger than it was compared to the pre-pandemic economy (**Figure 1A**). On the other hand, the December 2020 forecast only predicted a 3% increase since 2019. The global forecasts closely mirror those for the U.S. (**Figure 1B**).

One of the primary concerns in the global economy has been shortages in the global supply chain. Costs for manufactured goods are 11% higher than they were at the beginning of 2020. There have

been large supply chain disruptions as firms struggle to keep up with rising demand. In the most recent Institute for Supply Management (ISM) report, supplier deliveries were the slowest since April 1974. Moreover, input prices rose at the fastest rate since July 2008,

when oil prices peaked at \$140 a barrel. These concerns are echoed in the annual survey of Montana manufacturers and in national surveys. In a survey conducted by the National Association of Manufacturers (NAM) respondents expected raw material and other input costs to rise about 7.5% over the next year or so, the highest since 2018, when the question was first introduced in the NAM survey.

Montana manufacturers are exposed to the global economy. **Table 1** displays the International Monetary Fund's (IMF) predictions for Montana's 10 largest export markets for manufactures through 2022 (shaded columns are forecasts).

With the exception of China and Taiwan, all of Montana's primary export markets for manufactured goods declined, on average about -5.5% in 2020. Real GDP growth in 2021 is predicted to average over

By 2022Q4, the U.S. economy is forecast to be about 6% above pre-pandemic levels, roughly the same as the rest of the world. OECD countries may not return to pre-pandemic until 2022.

Figure 1A. Economic forecasts for the United States, 2020 and 2021. Source: Organisation for Economic Co-operation and Development.

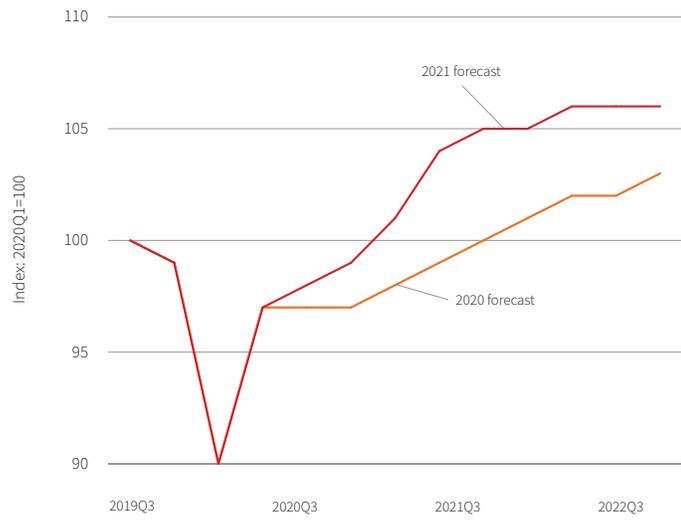


Figure 1B. Economic forecasts for the world, 2020 and 2021. Source: Organisation for Economic Co-operation and Development.

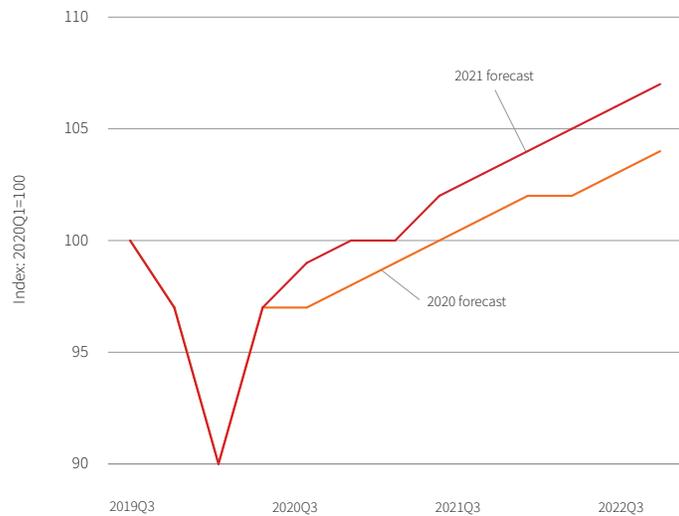


Table 1. Real GDP growth of 10 Montana's largest trading partners, in percent. Source: International Monetary Fund, Economic Outlook 2021, July.

Rank	Country	2019	2020	2021	2022
1	Canada	1.9	-5.3	6.3	4.5
2	China	6	2.3	8.1	5.7
3	South Korea	2.2	-0.9	4.3	3.4
4	Belgium	1.7	-6.4	4	3.1
5	Japan	0	-4.7	2.8	3
6	Mexico	-0.2	-8.3	6.3	4.2
7	Taiwan	3	3.1	4.7	3
8	Brazil	1.4	-4.1	5.3	1.9
9	UK	1.4	-9.8	7	4.8
10	Germany	0.6	-4.8	3.6	4.1

5% before settling down in 2022 to an average and more sustainable 3.7%. Because most developed countries grow in the neighborhood of 2% per year, most of the 2021 bounce back is simply recovering from the steep declines in 2020.

Europe and the European Union

The European Union's (EU) patchwork of anti-COVID measures and vaccination rates will likely lead to continued unbalanced growth across the region. This is becoming increasingly apparent as the delta variant of the coronavirus gains traction in Europe forcing some governments to reimpose anti-pandemic restrictions, which could slow the recovery. Inflation in the EU is still comfortably within the limits for the European Central Bank (ECB), and low compared to the United States, which allows the ECB to be looser with monetary policy.

All of Montana's export markets are forecast to have positive economic growth in 2021 and 2022.

Latin America and Canada – USMCA

Similarly, the fate of Latin American economies largely depends on how well they cope with COVID-19. Response to the pandemic in the region has been spotty at best, leading to the regional wildcard that remains politically uncertain, particularly in Brazil and Venezuela. In 2020, Brazil and Mexico, two of Montana's largest trading partners are forecast to experience growth at 5.3% and 6.3% respectively, according to IMF estimates in 2021.

Canada's fate is largely defined by the U.S. economy, which is its largest trading partner. Positive news stems from the reduction of

punitive tariffs on Canadian goods imported into the U.S. Also positive for Canadian exports is rising energy prices. The Canadian dollar has appreciated over 10% against the U.S. dollar, which could slow Canadian growth. Canada's forecasted 6.3% real GDP growth for 2021 is a positive sign.

Despite the Asian continent's sometimes erratic response to COVID-19, the continent is estimated to return to pre-COVID levels of output by the end of 2021.

China, Asia, and the Pacific

China and Taiwan are bright spots. Both of these countries grew throughout 2020 and are expected to experience strong growth in 2021. The IMF report states that the less developed Asian countries' economic activity will lag the rest of the region.

NATIONAL MANUFACTURING OVERVIEW

U.S. manufacturing is sometimes pictured as an anachronistic activity in the new knowledge-based economy. New investments, often incorporating the latest technology, are particularly important for manufacturers as they constantly improve productivity and efficiency. Supply disruptions resulting from the global pandemic have only intensified the need to reduce inefficiencies.

Figure 2 shows an index (2010Q1=100) of U.S. manufacturing and overall nonfarm employment and manufacturing labor productivity. We can see that both nonfarm and manufacturing employment have trended upwards, with sharp declines associated with the 2020 COVID recession.

As the figure shows, the rise in manufacturing employment has been offset by decreases in productivity, which is measured as out-

put per hour per worker. The long-term decline in productivity is sometimes misinterpreted as an indicator of the poor overall health of the industry. However, increases in manufacturing employment change the relationship between inputs and outputs. Decreases in productivity do not necessarily mean less output is produced or a 10% growth in output may not be associated with an equivalent change in some or all of the inputs.

Figure 3 presents indices of manufacturing and national nonfarm business production, adjusted for inflation (2010Q1=100). It's a similar story to the discussion above, with nonfarm output and manufacturing overall output following a similar trajectory from 2010 to 2014 when overall output began to rise relative to manufacturing. We can see a large drop in nonfarm and manufacturing output during the 2020 recession with each beginning to recover in mid-

Figure 2. U.S. nonfarm and manufacturing employment and manufacturing labor productivity. Source: Bureau of Labor Statistics.

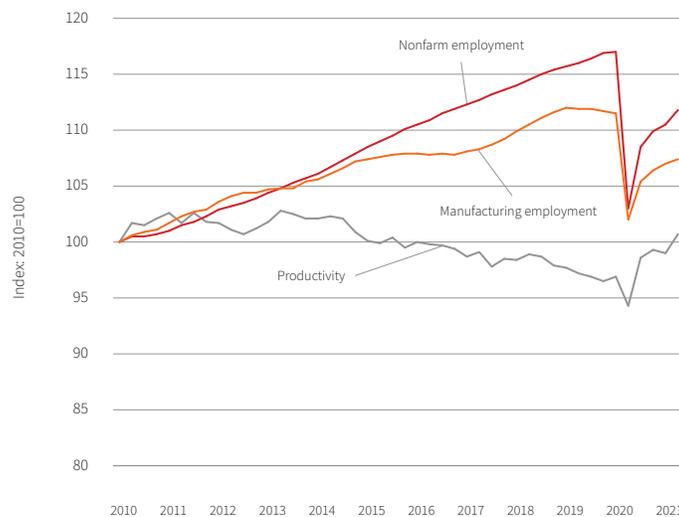


Figure 3. Manufacturing and all nonfarm industries: output index. Source: Bureau of Economic Analysis.

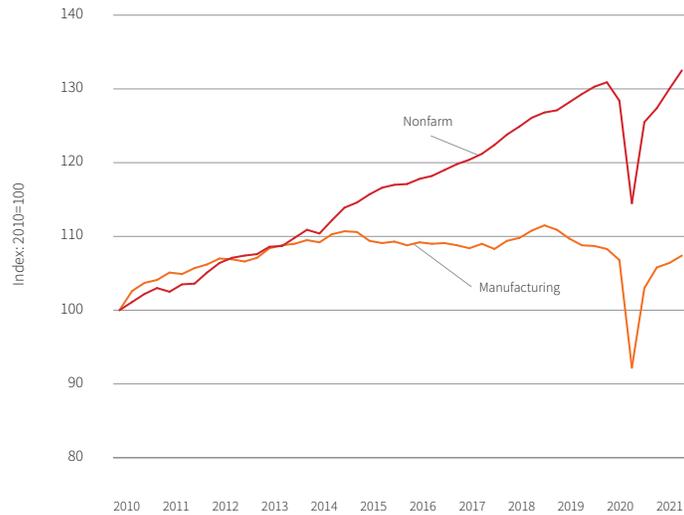
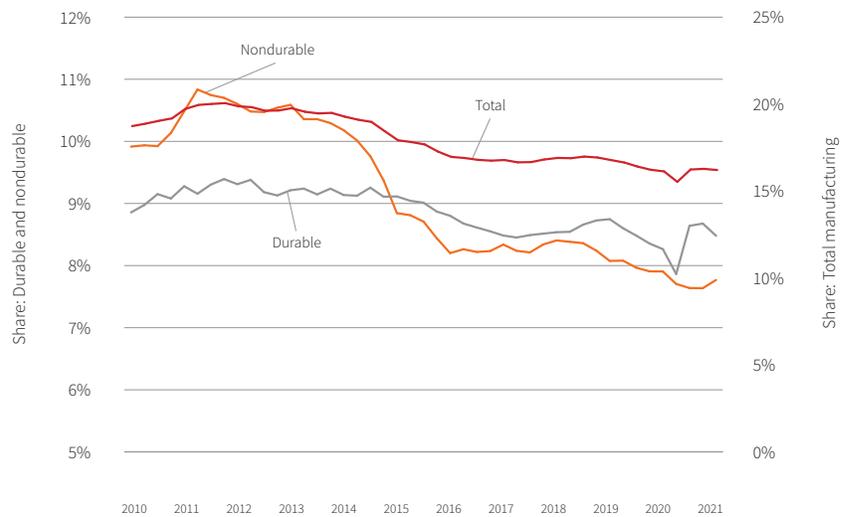


Figure 4. Manufacturing share of gross output. Source: BBER calculations using data from the Bureau of Economic Analysis.

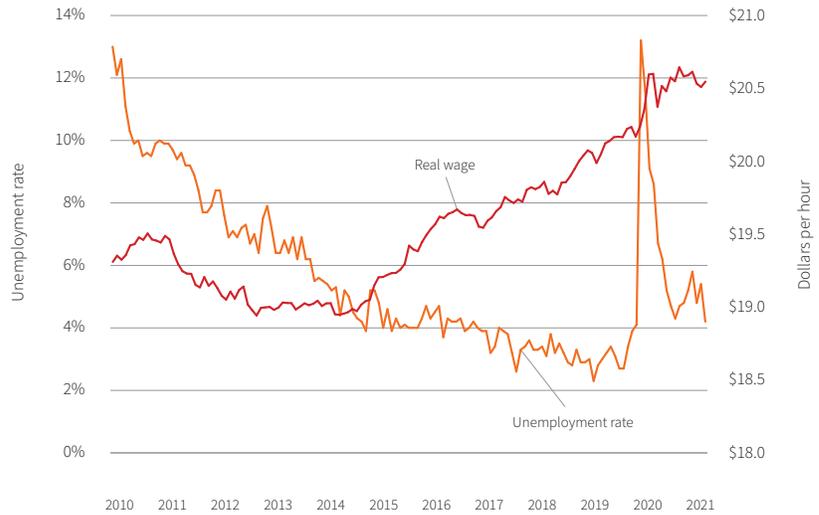


2020. However, while nonfarm output resumes its' pre-recessionary upward trend, the manufacturing sector's growth trend slowed.

Turning our attention to differences across durable and nondurable goods between 2010 and 2020, **Figure 4** shows the share of overall output to overall, durable and nondurable manufacturing. The data shows that in 2013 nondurable goods manufacturing fell further and recovered slower than durable manufacturing. During the pandemic year of 2020, durable manufacturing fell more sharply as a share of output, but has rebounded relatively quickly relative to nondurable manufacturing.

Between 2013 and 2020, inflation adjusted wages increased 6% to \$24 per hour, and the manufacturing unemployment rate has been falling since 2010 and fell to around 2% prior to the pandemic recession. By the end of 2020, after spiking 13%, manufacturing unemployment hovered around 4%.

Figure 5. Manufacturing real wage and unemployment. Sources: Bureau of Labor Statistics and the Bureau of Economic Analysis.



For manufacturing workers there are some positive signs. **Figure 5** shows the national inflation adjusted average hourly wage for manufacturing workers (in 2012 dollars) and the manufacturing unemployment rate.

In the aftermath of the Great Recession manufacturing wages accelerated, but between 2010 and 2014 they saw a decline in their spending power. However, between 2013 and 2019 real wages increased 6% to an inflation adjusted pre-COVID level of about \$20 per hour. The jump in wages in 2020 is due to the \$1,200 sent to in-

dividuals from the CARES Act. The manufacturing unemployment rate has been falling since 2009 and fell to around 2.3% prior to the recession. As with most industries manufacturing unemployment rose sharply in the first and second quarters of 2020, rising to a high of 13.2%, about 1.5% below the national average.



MANUFACTURING IN MONTANA

Manufacturing in Montana has remained a stable economic sector for the last decade. Between 2010 and 2020 manufacturing, as a share of total Montana employment, has risen slightly from 3.9% to 4.5% to 21,400. Similarly, manufacturing’s labor income as a share of total earnings rose from 4.8% to 5.1% to \$1.1 billion in 2020. Average annual pay by Montana’s manufacturers was \$52,666 in 2020. In 2020, manufacturing’s share of total state output climbed to 7.9% at \$3.5 billion.

Montana manufacturing has been growing relative to the U.S. as a whole. Nationally, manufacturing output was 11% higher in 2020 than 2010 and in Montana, manufacturing is 45% higher over the same period. Correspondingly, Montana manufacturing employ-

Manufacturing in Montana:

- Accounts for 5.1% of total private state income equaling \$1.1 billion.
- Employs 4.5% of Montana’s workforce, with about 21,400 employees with an average annual pay of \$51,666, which is 3.9% above the state average.
- Produced 7.9% of Montana’s output with a value of \$3.5 billion.

Figure 6. U.S. and Montana manufacturing production. Source: Bureau Economic Analysis.



ment also grew faster than the national average. Montana manufacturing employment was 21.3% higher at the end of 2020 than in 2010 whereas in the U.S. it was 6.7% higher.

Comparisons between Montana and nationwide manufacturing output since 2010 can be found in **Figure 6A**, which shows an index of all manufacturing production (2010Q1=100).

Between 2010 and 2013 Montana’s manufacturing kept pace with the national economy. However, after 2013 Montana’s manufacturing output accelerated relative to the U.S. Manufacturing in Montana is about 42% larger today than it was in 2010, while in the U.S. it is 16% larger.

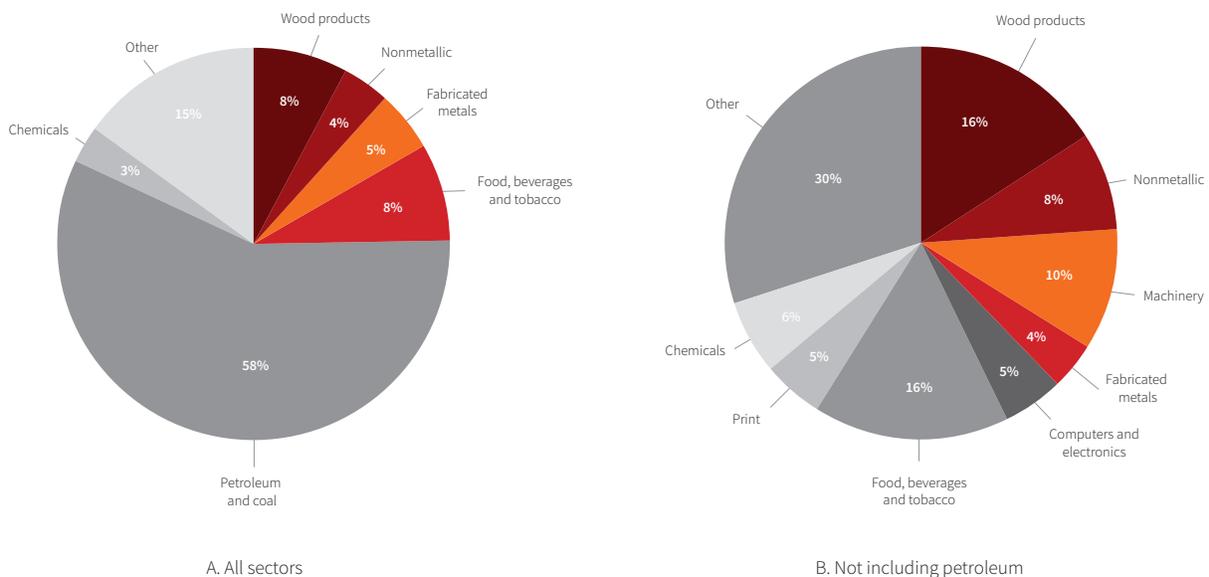
Montana durable goods manufacturing has mirrored patterns in the national average (**Figure 6B**), but has similarly outpaced the national economy. Nondurable manufacturing is presented in

In 2020, Montana’s manufacturing employment and output were 21.3% and 45% higher respectively than in 2010; comparatively, U.S. employment and output only rose 11% and 6.7%, respectively.

Figure 6C. U.S. nondurable manufacturing growth has essentially flattened since 2010 but has grown significantly in Montana, fueled by growth in the petroleum and coal and food and beverage sectors. The sharp decline in nondurable manufacturing in 2016 is from declines in the value of manufactured goods in the petroleum and coal sector because of a sharp fall in oil prices.

Figure 7A shows the share of total manufacturing earnings of the six largest sectors in Montana; only sectors with a 3% or larger share are presented.

Figure 7. Composition of manufacturing in 2019 (percent of total manufacturing). Source: Bureau of Labor Statistics.

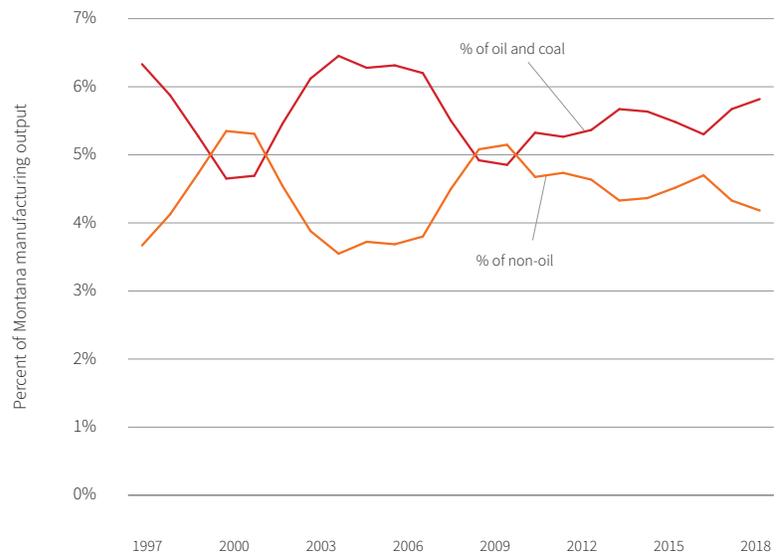


In 2019, petroleum and coal manufacturing was the largest manufacturing sector in the state, followed by food and beverages, and wood manufacturing.

The largest Montana manufacturing industries in 2019, the most recent available data, were associated with the processing of crude oil and forest resources. Petroleum and coal products (primarily oil refining) was the largest manufacturing industry accounting for 58.3% of total manufacturing earnings in 2019. The next largest industry was food, beverages and tobacco, representing 7.9% of earnings. Wood product manufacturing, fabricated metals, nonmetallic product and chemical manufacturing round out the remaining four sectors. All other sectors accounted for about 15% of total manufacturing production.

What is notable is the size of the oil and coal manufacturing sector relative to the other manufacturing industries. It should be noted that the value of petroleum and coal manufactured goods are closely aligned with mineral prices – for example, oil accounts for about 51% of gas prices – and can therefore be highly volatile. **Figure 8** shows the share of petroleum and coal manufacturing relative to the other manufacturing sectors from 1995–2019. As shown, this sector’s share of output has been increasing since 2010 after falling from a high of 65% in 2004.

Figure 8. Petroleum and coal production as share of manufacturing output. Source: Bureau of Labor Statistics.



Removing this sector from the data provides insight into how the remaining sectors are distributed (**Figure 7B**) – again only sectors with a 3% or better share of manufacturing output are included.

Manufacturing employment in Montana has recovered more quickly than the nation as a whole, according to the most recent employment data. National manufacturing remains roughly 500 thousand below February 2020 pre-pandemic levels, but Montana manufacturing employment is above pre-pandemic levels (**Figure 9A**).

What is driving this growth is the rapid recovery of nondurable manufactured goods. As shown in **Figure 9B**, durable manufacturing employment returned to levels seen in early 2020, but nondurable employment is now greater than it was before the economic shut down. Overall, manufacturing has weathered this storm well. If we compare manufacturing employment to overall nonfarm employment in the state, we can see that nonfarm employment remains roughly 20 thousand jobs below 2020 levels (**Figure 10**).

Manufacturing accounts for about 16% of total base earnings similar to mining, transportation and federal civilian earnings. Base industries are those located in a state, but sell most of their products elsewhere.

Figure 9A. National and Montana manufacturing employment, relative to Feb. 2020. Source: Bureau of Labor Statistics.

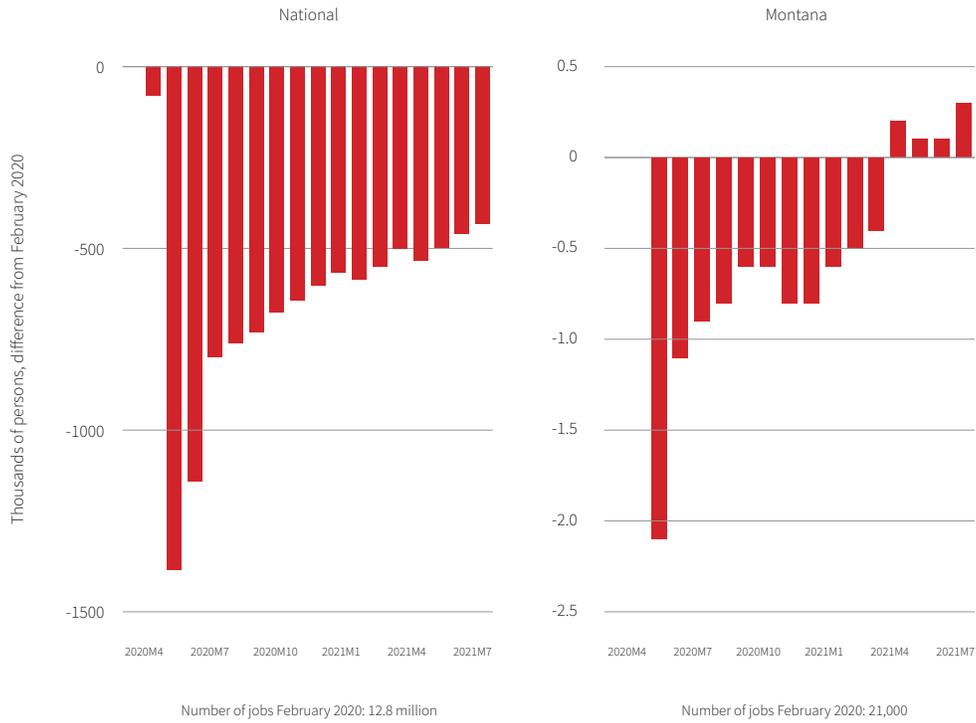
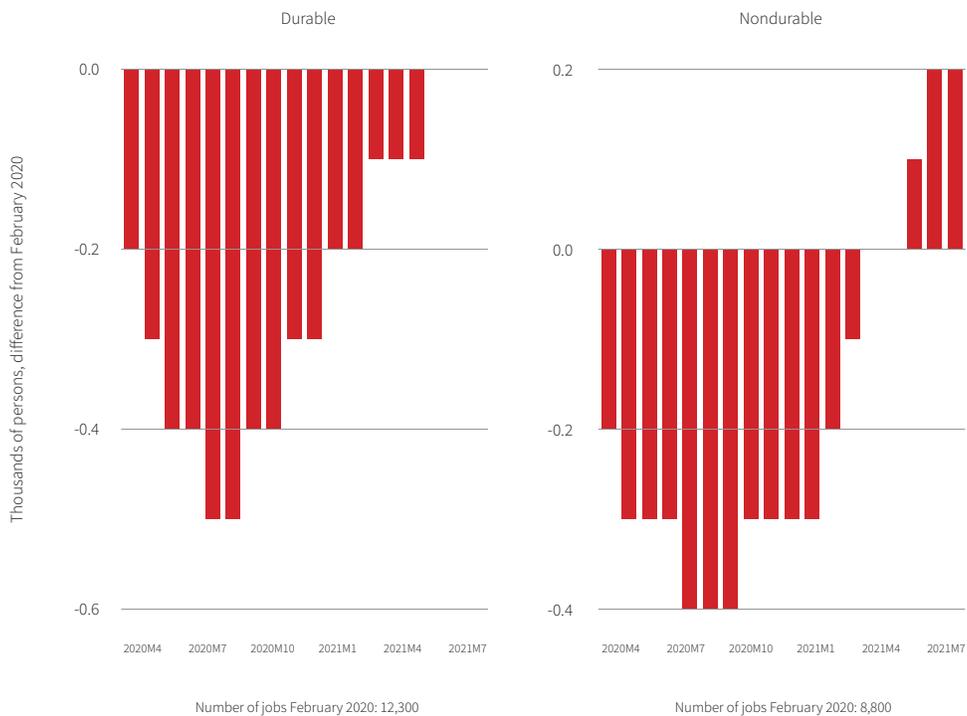


Figure 9B. Montana manufacturing employment, relative to Feb. 2020. Source: Bureau of Labor Statistics.



Trends in the Montana economy are primarily determined by its base industries. Base industries are those which sell most of their products out of state or are otherwise influenced by factors beyond the state's borders. Base industries inject new funds into the state economy and are responsible for creating income and jobs. To quantify the role base industries play in the Montana economy we consider labor earnings for each sector.

Labor earnings data is more appropriate for analyzing trends from one year to the next and for periods of a decade or more. The share

of basic earnings over the period 2009-19 in each of Montana's base industries, the most recent data available, are shown in **Figure 11**.

Collectively, the federal government, which includes the military, accounts for about 23% of base industry earnings, just above tourism at 21%. Manufacturing accounts for about 16% of total base earnings, which is similar to mining, transportation and federal civilian earnings. Note, these shares are pre-COVID and it is likely that tourism's share of base industry earnings will be somewhat lower in 2020.

Figure 10. Nonfarm and manufacturing employment in Montana, relative to Feb 2020. Source: Bureau of Labor Statistics.

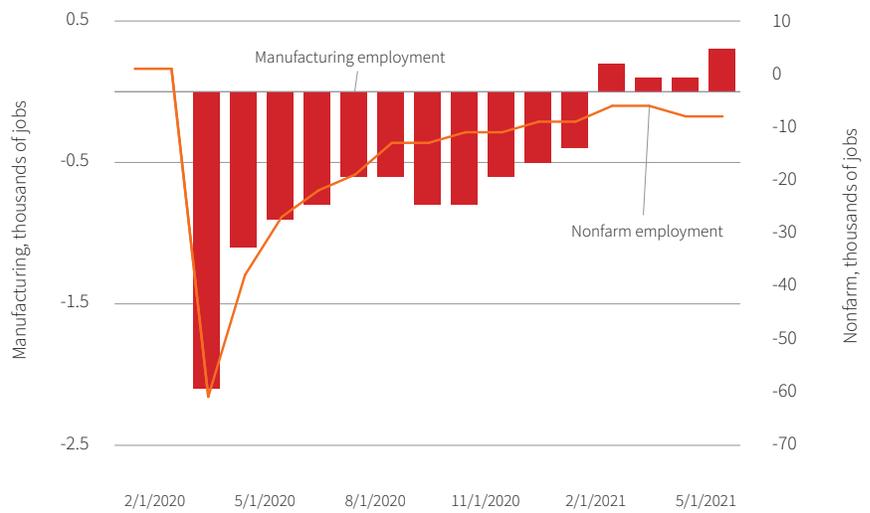
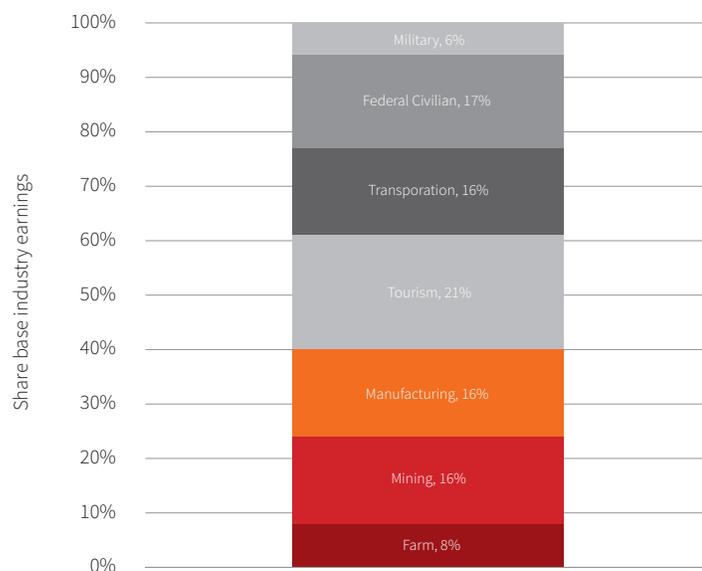


Figure 11. Share of basic earnings in Montana, 2009-19. Sources: Bureau of Labor Statistics and the Bureau of Economic Analysis.



MANUFACTURING ESTABLISHMENTS

According to the Bureau of Labor Statistics, 1,666 Montana manufacturing establishments in 2020 have employees. Dunn and Bradstreet lists over 3,900 manufacturers in Montana. This latter number includes sole proprietors, as well as those with employees. To better understand structural changes in Montana manufacturing, we look at the one-year average and 10-year average growth rate for manufacturing firms from 2010 to 2020 (**Table 2**). The table is broken down by the NAICS industry code. The 10-year average growth rate is a better way of gauging each sector as global market conditions change considerably year to year, particularly in the food and energy markets. Sectors such as petroleum and oil require significant capital investments making changes to the number of firms less likely.

The fastest growing industries are apparel, and beverages and tobacco with an average 10-year growth rate of 12.3% and 12.2% respectively.

Firms with less than 20 employees account for roughly 85% of all manufacturing businesses in Montana. Only Alaska has a higher percentage.

The fastest-growing industries in terms of firm creation are apparel, and beverages and tobacco, with an average 10-year growth rate of 12.3% and 12.2%, respectively. These sectors are over three times that of the third fast-growing sector, chemicals (332). Much of the growth in beverages and tobacco occur from the formation of breweries, wineries and distilleries. One of Montana's traditional industries, wood products, retreated over this period losing 0.6% of firms. However, furniture manufacturing saw a slight resurgence, 0.2%. Rounding out the bottom is primary metals, losing an average of 4.8% of firms every year over 10 years.

Montana's manufacturing firms tend to be small businesses following a similar trajectory to the U.S. as a whole. **Table 3** breaks down manufacturing by sector and the number of employees. As the table shows, most firms, 51.1%, have less than five employees,

Table 2. Growth of manufacturing establishments, 2010-20. Source: Bureau of Labor Statistics, * = nondurables.

NAICS	Industry	Firms in 2010	Firms in 2020	10-year average growth	1-year growth
311	Food*	176	178	0.1%	0.2%
312	Beverage & Tobacco*	47	149	12.2%	12.3%
313	Textile Mills*	5	4	-2.2%	-0.3%
314	Textile Product Mills*	42	35	-1.8%	-1.6%
315	Apparel*	5	16	12.3%	13.4%
316	Leather & Allied Products*	15	30	7.2%	7.7%
321	Wood Products	156	147	-0.6%	-0.5%
322	Paper*	5	2	-8.8%	-2.8%
323	Printing & Related*	85	102	1.8%	1.9%
324	Petroleum & Coal*	11	9	-2%	-1.8%
325	Chemicals*	43	64	4.1%	4.2%
326	Plastic & Rubber*	21	24	1.3%	1.6%
327	Nonmetallic Minerals	83	103	2.2%	2.2%
331	Primary Metals	22	13	-5.1%	-4.8%
332	Fabricated Metals	178	276	4.5%	4.5%
333	Machinery	37	62	5.3%	5.6%
334	Computer & Electronics	35	66	6.5%	6.6%
335	Electrical Equipment & Appliances	20	21	0.5%	0.7%
336	Transport Equipment	37	49	2.8%	3.2%
337	Furniture & Related	129	132	0.2%	0.3%
339	Misc.	161	184	1.3%	1.4%

Table 3. Firms by number of employees in 2019. Source: Annual Economic Surveys, County Business Patterns 2019, * = nondurables.

NAICS	Industry	<5	5 - 9	10 - 19	20 - 49	50 - 99	> 99	Total
311	Food*	63	26	30	22	5	3	149
312	Beverage & Tobacco*	42	33	25	14	4	0	118
313	Textile Mills*	3	0	0	0	0	0	3
314	Textile Product Mills*	21	5	6	0	0	0	32
315	Apparel*	9	0	0	0	0	0	9
316	Leather & Allied Products*	16	6	0	0	0	0	22
321	Wood Products	62	23	22	14	7	8	136
323	Printing & Related*	45	20	12	10	0	0	87
324	Petroleum & Coal*	0	0	0	0	0	6	6
325	Chemicals*	17	9	11	4	0	0	41
326	Plastic & Rubber*	9	0	3	3	3	0	18
327	Nonmetallic Minerals	39	17	16	11	5	0	88
331	Primary Metals	9	0	0	0	0	3	12
332	Fabricated Metals	128	41	27	28	4	0	228
333	Machinery	26	7	9	9	0	0	51
334	Computer & Electronics	8	5	0	6	4	0	23
336	Electrical Equipment & Appliances	25	9	7	5	0	3	49
337	Transport Equipment	52	26	13	4	0	0	95
339	Furniture & Related	99	23	11	10	5	3	151
	Total	673	250	192	140	37	26	1318
	Percent of total	51.1%	19%	14.6%	10.6%	2.8%	2%	100%

Table 4. Growth of manufacturing earnings, 2010-2020 (in thousands). Source: Bureau of Labor Statistics, * = nondurables.

NACIS	Industry	2010	2020	10-year average growth	1-year growth
311	Food*	\$81,048	\$109,481	3.1%	3.1%
312	Beverage & Tobacco*	\$21,613	\$40,022	6.4%	6.6%
314	Textile Product Mills*	\$4,639	\$5,136	1%	1.4%
315	Apparel*	--	\$881	--	-4.5%
316	Leather & Allied Products*	\$1,122	\$1,918	5.5%	6.4%
321	Wood Products	\$99,748	\$133,516	3%	3%
323	Printing & Related*	\$29,119	\$42,888	3.9%	4.1%
324	Petroleum & Coal*	\$104,996	\$170,337	5%	5.1%
325	Chemicals*	\$50,588	\$70,450	3.4%	4.6%
326	Plastic & Rubber*	\$10,836	\$22,023	7.3%	8.2%
327	Nonmetallic Minerals	\$30,965	\$74,127	9.1%	11.4%
331	Primary Metals	\$3,519	\$9,856	10.8%	12.1%
332	Fabricated Metals	\$58,367	\$119,089	7.4%	7.7%
333	Machinery	\$54,884	\$80,683	3.9%	4%
334	Computer & Electronics	\$20,181	\$59,902	11.5%	11.8%
335	Electrical Equipment & Appliances	\$8,527	\$10,576	2.2%	3%
336	Transport Equipment	\$19,607	\$44,949	8.7%	9.1%
337	Furniture & Related	\$18,731	\$26,607	3.6%	3.7%
339	Misc.	\$57,112	\$82,197	3.7%	3.8%

84.5% have less than twenty employees. The largest number of firms are in fabricated metals, 128, and over half are small-scale operations. The firms with over ninety-nine employees concentrate in four sectors wood products, petroleum and coal, food, and transportation equipment.

Computer and electronics has experienced the fastest earnings growth at 11.5%. Primary metals averaged 10.8% earnings growth per year between 2010 and 2020.

MANUFACTURING EARNINGS

Table 4 provides insights into sector earning growth using the same 10-year annual averages as in Table 2. Price volatility in some sectors distorts the value of output measures, such as GSP, for specific industries, such as petroleum refining. Consequently, worker earnings are the best measure of the composition of manufacturing because it is the amount earned by manufacturing workers in the state.

While the apparel and beverage and tobacco industries are the fastest growing in terms of the number of firms, due to relatively low entry costs, computer and electronics have experienced the most rapid earnings growth. However, it should be noted that computer and electronics make up a small share of total earnings. In 2020 computer and electronics accounted for \$60 thousand in earnings. The largest sectors in terms of earnings were petroleum and wood products, with 2020 earnings of \$170 million and \$133 million, respectively. However, average annual earnings growth over 10 years was 5% and 3%.

Montana’s third-largest, by earnings, sector in 2020 was nonmetallic mineral products which grew a rapid 9.1% per year over 10 years.

MANUFACTURING EMPLOYMENT BY INDUSTRY

Finally, we turn our attention to manufacturing employment in **Table 5**. Given the fast growth of firms in apparel, and beverages and tobacco, it is not surprising that these industries leads in terms of longer-term employment growth trends. Short-term employment growth in apparel is 25.4%. Primary metals is also averaging a healthy 10-year growth rate of 6.4%.

The largest sector in terms of the number of employees continues to be wood products, and this has stayed relatively stable since 2010. Second is food, with 2,596 employees with a modest growth of 0.4%. The only shrinking sector is textile mill products, with a negative rate of 0.5%

As discussed above, growth has been strong in apparel employment, but this is composed of only 44 employees in 2020. The sec-

Table 5. Growth of manufacturing employment, 2010-2020. Source: Bureau of Labor Statistics.

NACIS	Industry	2010	2020	10-year mean growth	1-year growth
311	Food*	2,506	2,596	0.4%	0.4%
312	Beverage & Tobacco*	713	1,540	8%	8.35%
314	Textile Product Mills*	198	185	-0.7%	-0.5%
315	Apparel*	--	44	--	25.4%
316	Leather & Allied Products*	60	73	2%	2.4%
321	Wood Products	2,614	2,623	0	0.1%
323	Printing & Related*	864	964	1.1%	1.3%
324	Petroleum & Coal*	1,076	1,332	2.2%	2.2%
325	Chemicals*	927	1,147	2.2%	2.8%
326	Plastic & Rubber*	293	527	6%	6.8%
327	Nonmetallic Minerals	805	1,228	4.3%	5.3%
331	Primary Metals	116	215	6.4%	7.5%
332	Fabricated Metals	1,555	2,467	4.7%	5%
333	Machinery	1,008	1,191	1.7%	1.8%
334	Computer & Electronics	479	790	5.1%	5.3%
335	Electrical Equipment & Appliances	178	179	0.1%	0.9%
336	Transport Equipment	469	816	5.7%	6%
337	Furniture & Related	626	642	0.3%	0.4%
339	Misc.	1,601	1,824	1.3%	1.4%

ond fastest employment growth is plastics and rubber, with 527 employees. This sector has been growing at 6.8% over the 10-year horizon.

MONTANA'S MANUFACTURING EXPORTS

After a burst of growth in the mid-2000s, the value of Montana exports has remained relatively stable since 2012. Nevertheless, recent volatility in worldwide economic trends and policies have had an impact on Montana exports. The trend in Montana manufacturing exports adjusted for inflation from 2005 to 2020 is presented in **Figure 12** and are compared to real Montana gross state product, all in 2020 dollars. In 2020, Montana exports were about 60% above their 2005 level. The decline in global economic activity is evident in the decline in exports after 2019.

In 2020, Montana manufacturers exported \$860.2 million worth of goods, a 30% decline from 2019 reflecting the health of the global economy in 2020. Montana manufacturing exports by industry are

Food manufacturing (value-added ag) has 2,596 employees and has a growth rate of about 0.4%.

Another notable sector is miscellaneous durable goods with 1,824 employees. The two most notable subcategories are sporting goods and equipment, and medical equipment and supplies (including dental labs).

reported in **Table 6**, ranked by export value in constant 2020 dollars for the years 2018 to 2020, the share of total exports by sector, and the annual growth of exports for the years 2018 to 2019 and 2019 to 2020. Given the unique economic environment in 2020, growth from 2018 to 2019 represents a normal year.

The largest export sector continues to be chemicals (NAICS 325) in 2020, accounting for almost one-third of Montana exports, closely followed by machinery (333), which replaced beverages and

Table 6. Manufacturing exports by sector ranked, 2018-20 (millions of 2020 dollars). Sources: USA Trade, U.S. Census Bureau, * = nondurable

Rank 2020	NAICS	Export	2018	2019	2020	Share 2020	Growth 2018-19	Growth 2019-20
1	325*	Chemicals	\$318.9	\$298.9	\$278.8	32.4%	-6.3%	-6.7%
2	333	Machinery, Except Electrical	\$160.8	\$174.2	\$138.4	16.1%	8.3%	-20.6%
3	336	Transportation Equipment	\$79.9	\$146.3	\$87.2	10.1%	83.2%	-40.4%
4	311*	Food	\$33.1	\$51.3	\$55.2	6.4%	54.7%	7.7%
5	327	Nonmetallic Minerals	\$73.2	\$69.2	\$52.3	6.1%	-5.5%	-24.4%
6	334	Computer & Electronics	\$45.6	\$45.1	\$38.5	4.5%	-1.1%	-14.6%
7	324*	Petroleum & Coal	\$58.4	\$43.6	\$33.4	3.9%	-25.3%	-23.4%
8	331	Primary Metals	\$54.5	\$30.3	\$33.1	3.9%	-44.3%	9.2%
9	321	Wood Products	\$34.8	\$31.7	\$31.2	3.6%	-8.9%	-1.6%
10	312*	Beverages & Tobacco	\$305.7	\$240.7	\$30.3	3.5%	-21.3%	-87.4%
11	335	Electrical Equipment & Appliances	\$22.8	\$35.0	\$28.6	3.3%	53.9%	-18.3%
12	339	Misc.	\$28.0	\$28.4	\$25.3	2.9%	1.3%	-10.7%
13	332	Fabricated Metals	\$8.2	\$19.4	\$8.2	1.0%	137.5%	-57.5%
14	316*	Leather & Allied Products	\$6.8	\$7.9	\$8.2	1.0%	17.4%	3.6%
15	326*	Plastics & Rubber	\$6.9	\$6.9	\$6.4	0.7%	-0.4%	-7.1%
16	315*	Apparel	\$2.8	\$2.6	\$1.6	0.2%	-9.4%	-36.8%
17	337	Furniture & Related	\$2.2	\$1.5	\$1.3	0.1%	-31.6%	-13.3%
18	314*	Textile Product Mills	\$0.3	\$1.0	\$0.8	0.1%	211.1%	-25.6%
19	313*	Textiles Mills	\$1.9	\$1.2	\$0.5	0.1%	-34.2%	-61.0%
20	323*	Printed & Related	\$0.7	\$0.6	\$0.5	0.1%	-3.8%	-26.1%
21	322*	Paper	\$4.8	\$2.2	\$0.3	0.0%	-55.2%	-87.0%
	Total		\$1,249.6	\$1,226.0	\$860.2	100%	-1.9%	-29.8%

Figure 12. Montana inflation adjusted manufacturing exports and GSP. Sources: USA Trade, U.S. Census Bureau, via Montana Department of Commerce.

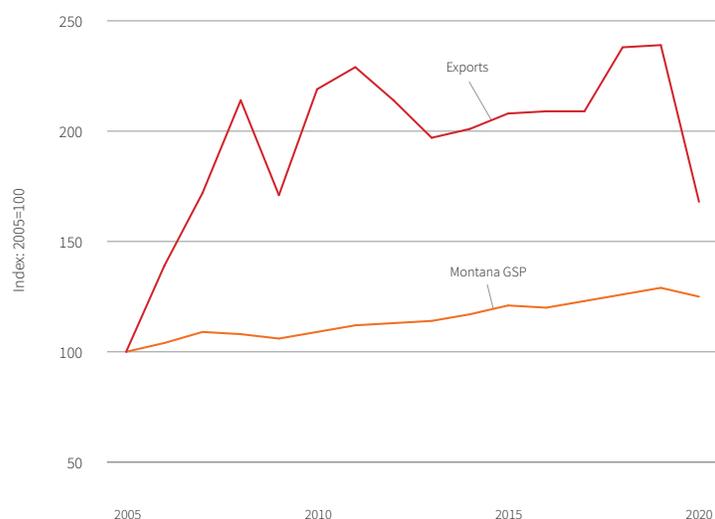


Table 7. Top destinations for Montana manufacturing exports (millions 2020 dollars). Sources: USA Trade, U.S. Census Bureau.

Rank	Country	2018	2019	2020	Share	Growth 2018-19	Growth 2019-20
1	Canada	\$585.9	\$572.7	\$256.1	29.8%	-2.2%	-55.3%
2	China	\$102.5	\$95.3	\$83.9	9.8%	-7%	-11.9%
3	South Korea	\$77.3	\$61.3	\$53.2	6.2%	-20.7%	-13.1%
4	Belgium	\$51.3	\$53.9	\$48.6	5.7%	5.1%	-9.8%
5	Japan	\$46.6	\$63.0	\$47.4	5.5%	35%	-24.7%
6	Mexico	\$29.5	\$46.8	\$46.0	5.3%	58.8%	-1.8%
7	Taiwan	\$52.1	\$56.7	\$40.1	4.7%	9%	-29.4%
8	Brazil	\$5.8	\$5.2	\$38.8	4.5%	-9.2%	641.6%
9	UK	\$30.1	\$38.5	\$29.1	3.4%	27.8%	-24.4%
10	Germany	\$19.4	\$32.4	\$22.8	2.7%	67.1%	-29.7%
11	Netherlands	\$17.3	\$15.3	\$16.8	2%	-12%	10.2%
12	Singapore	\$14.7	\$12.1	\$16.6	1.9%	-17.7%	37%
13	France	\$15.5	\$18.1	\$16.2	1.9%	16.5%	-10.4%
14	Australia	\$15.7	\$8.4	\$12.6	1.5%	-46.8%	50.6%
15	Malaysia	\$12.3	\$8.3	\$11.5	1.3%	-32.6%	38.8%
16	Chile	\$4.1	\$7.1	\$9.6	1.1%	71.2%	35.8%
17	Sweden	\$10.9	\$10.7	\$7.8	0.9%	-1.5%	-27.5%
18	Costa Rica	\$6.9	\$8.2	\$7.3	0.9%	17.9%	-10.1%
19	Israel	\$2.0	\$3.2	\$7.1	0.8%	56.4%	122.3%
20	Indonesia	\$6.1	\$13.0	\$5.4	0.6%	111.5%	-58.6%
	Others	\$143.5	\$95.9	\$83.2	9.7%	-33.2%	-13.2%
	Total	\$1,249.6	\$1,226.0	\$860.2	100%	-1.9%	-29.8%

tobacco (312) ranked 10th in 2020, with an export value of \$124 million. Next was transportation equipment (336) accounting for about 10% of total exports. These three sectors combined for almost 60% of all manufactured exports. It's worth noting that beverages and tobacco exports declined by 87% in 2020.

Between 2019 and 2020, beverage and tobacco exports fell 87.4%. In 2019, this sector was the second largest manufactured export in Montana. In 2020, it was 10th.

Table 7 reports the same statistics as Table 6 organized by the top 20 destinations of Montana manufacturing exports. These 20 countries account for about 93% of Montana exports, the 10 largest destinations account for about 75% of manufactured exports. In 2020, Canada was the primary export market accounting for almost 30% of Montana exports. The next two export destinations, China and South Korea, have 9.8% and 6.2% shares respectively. After Canada, seven of the remaining 19 export destinations are in Asia, six in Europe, four in Latin America. The remaining two are Australia and Israel.

MONTANA MANUFACTURING FORECAST

As with the national economy, the short-term severity of the COVID-19 recession requires that we look to the future to gain insight about current economic conditions that will affect manufacturing in the years to come. In **Figure 13A-B** we provide forecasts for manufacturing earnings and employment through 2023. The forecasts are based on estimates from IHS Markit, which provides forecasts for the overall U.S. economy through 2035.

In 2020, IHS Markit introduced three separate forecasts: a benchmark, an optimistic forecast and a negative forecast. The optimistic forecast (probability is 30%) reflects an economy that eases containment measures, accelerates vaccinations and adds more stimulus. The negative forecast (20% probability) occurs if the recovery stumbles because consumers slow spending. The forecasts were conducted before the current growth of cases due to the delta variant.

While earnings are not projected to return to 2020 levels by 2024, current employment data does support the optimistic forecast as

By the end of 2022, manufacturing employment is estimated to recover to 2019Q1 levels, which reflects the current state of manufacturing jobs in Montana, but earnings are less optimistic.

manufacturing employment has already returned to pre-pandemic levels in Montana.

An important caveat is that the years ahead remain far more uncertain than in previous recessionary environments. The forecast analysis presented in this report factors in only the single hit recession, but under three different scenarios. The delta variant is increasing unabated and many countries are experiencing a resurgence. Several large states are also experiencing a resurgence – California, New York, Texas, and in particular Florida all experienced significant growth in cases since July, so the future economic situation remains highly fluid.

Figure 13A. Forecast manufacturing earnings.
Sources: BBER estimates using data from IHS Markit, BLS, BEA.

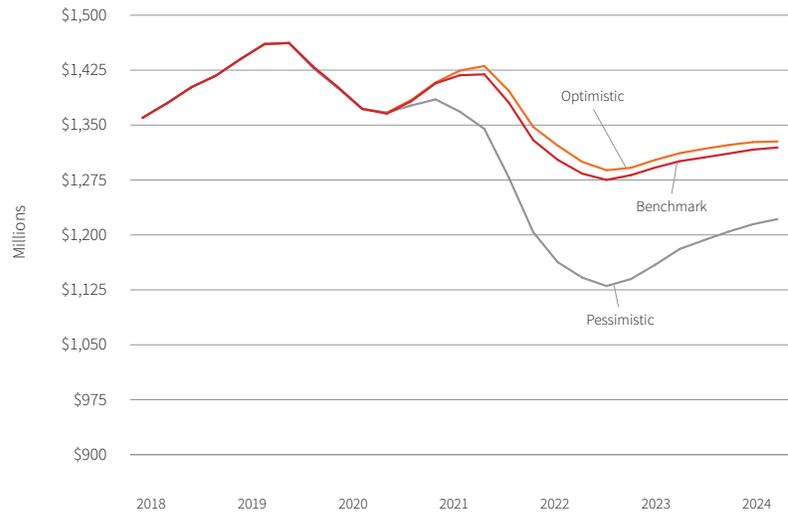
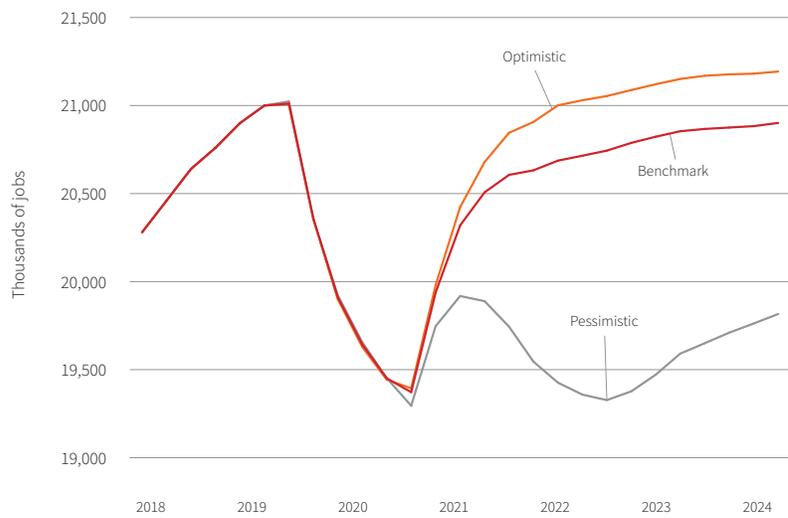


Figure 13B. Forecast manufacturing employment.
Sources: BBER estimates using data from IHS Markit, BLS, BEA.



MANUFACTURER'S SURVEY

Montana manufacturers are a diverse group of small- to medium-sized firms producing everything from beer to high-tech products. The Bureau of Business and Economic Research surveys manufacturers each year to gain insight into the previous year and inquire about their expectations for the upcoming year. Montana manufacturers were queried about a number of indicators and whether they thought the indicator would increase, decrease or stay the same during 2020. Overall, the survey finds the pandemic did not have a sizable negative effect on Montana manufacturing. Though firms did experience negative impacts from the pandemic, the state's manufacturers did not appear to face the same challenges as in the nation as a whole. Responses to expectations for the upcoming year can be found in the appendix.

YEAR IN REVIEW

Montana manufacturers were asked to report on their plant's performance in 2020. Responses to the survey fell to about 140 in 2020, about half the number in 2019. Montana manufacturers reported that 2020 was a moderately down year and about one-third of firms reported a better year. Forty percent saw a decline, which is understandable given the severe economic downturn experienced during a year of anti-pandemic policies, supply shortages and overall uncertainty.

Even during the COVID pandemic year of 2020, about one-third of manufacturing firms in Montana had positive sales and profits compared to 2019.

Questions 1–3 asked how Montana manufacturers fared vis-à-vis 2019 (**Table 8**). Overall, we can see that in 2020 roughly 25% of firms saw no change or an increase in their sales, production and profit compared to 2019.

In 2020, about 66% of firms made no new major capital investment (**Table 9**). For most firms a year of high economic uncertainty and declining consumer confidence during 2020 generates an environ-

Just over half of Montana manufacturing firms had no payroll changes and one-third experienced a shortage of workers at some time during 2020.

ment where investments are delayed if possible. Production capacity remained at 2019 levels for almost all of the state's manufacturers. Ninety-eight percent of respondents reported that no production capacity was eliminated during the year.

Employment for Montana's manufacturers was positive given the state of the economy (**Table 10**). The number of firms hiring more workers was smaller than those that were downsizing, 16% as compared to 25%. Most firms stayed the same. Notable too is that two-thirds of manufacturing firms did not experience any significant shortage of workers in 2020 (question 7).

Table 8. Questions 1-3 on sales, production and profit.

Q1. For calendar year 2020, did your plant's GROSS SALES increase, stay about the same, or decrease from 2019?			
<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
41.4%	22.1%	36.4%	141

Q2. For calendar year 2020, did your plant's PRODUCTION increase, stay about the same, or decrease from 2019?			
<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
41%	22.3%	36.7%	139

Q3. For calendar year 2020, did your plant's PROFITS increase, stay about the same, or decrease from 2019?			
<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
40%	27.9%	32.1%	140

Table 9. Questions 4-5 on investment and production.

Q4. By the end of 2020, did your plant make any major capital expenditure in facilities or equipment during the year?			
	<i>No</i>	<i>Yes</i>	<i>Total</i>
Total	66.2%	33.8%	139

Q5. By the end of 2020, did your plant permanently eliminate production capacity during the year?			
	<i>No</i>	<i>Yes</i>	<i>Total</i>
Total	97.8%	2.2%	139

Table 10. Questions 6-7 on employment.

Q6. By the end of 2020, did your plant's number of employees...				
	<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
Total	25%	59.3%	15.7%	140

Q7. Did your plant have a significant shortage of workers at any time during 2020?			
	<i>No</i>	<i>Yes</i>	<i>Total</i>
Total	64.5%	35.5%	141

THE COVID-19 PANDEMIC

Given the state of the economy in face of a global pandemic, the BBER manufacturing survey asked questions relating to COVID's impact on Montana's manufacturers. Generally, the partial shut-down of the economy did not have the medium to long term effects on the economy initially forecasted. Manufacturers in the state did report some understandable interruptions in the industry, but they did not turn out to be as problematic as they might have been. Table 11 quantifies survey responses to the open-end-

The most cited impact COVID-19 has had on Montana manufacturers is the lack of employees and supply chain interruptions and/or costs.

ed question "What were the major issues that affected your plant in 2020?"

Table 11. Major issues that affected individual manufacturing plants.

Issue	Number of responses
Inability to find employees	29
COVID-19	25
Transport problems fuel cost, shipping and supply chain problems	23
Availability or cost of raw materials	20
Increased demand	8
Decreased demand	8
Internal issues or personal issues unrelated to business, such as health	3
Government restrictions or general government issues	3



THE MONTANA MANUFACTURING EXTENSION CENTER

The Montana Manufacturing Extension Center (MMEC) is a statewide manufacturing outreach and assistance center staffed by full-time professionals with extensive experience in manufacturing and business in a variety of industries. MMEC's mission is to grow Montana's economy by helping manufacturers succeed.

MMEC serves the manufacturers of Montana by helping them assess and improve their manufacturing operations, providing trainings and workforce development, and leveraging research and technological developments to keep manufacturing competitive in the state.

Established in 1996, MMEC is housed in the Norm Asbjornson College of Engineering at Montana State University in Bozeman, with remote offices in Billings, Missoula, Kalispell, Great Falls and Butte. Its expertise includes staff with a combined experience of hundreds of years in manufacturing.

MMEC is also part of the National Institute of Standards and Technology's Manufacturing Extension Partnership (MEP) National Network. NIST is a non-regulatory agency of the U.S. Department of Commerce that promotes U.S. innovation and industrial competitiveness. The MEP National Network is a unique public-private partnership with centers in all 50 states and Puerto Rico dedicated to serving only small and medium-sized manufacturers, who pay fees for services provided.

Since 2000, MMEC's clients have reported project impacts to their businesses through an independent third-party survey. Results of these surveys show that MMEC has strengthened Montana's manufacturing economy between 2000 and 2020 by generating:

- **\$340 million** in new investments.
- **\$1.35 billion** in new and retained sales.
- **6,496** new and retained jobs.
- **\$170 million** in cost savings.

EVALUATION AND ECONOMIC IMPACT OF THE MONTANA MANUFACTURING EXTENSION CENTER

The MMEC evaluation process follows guidelines developed by the National Institute of Standards and Technology (NIST) as part of its management information reporting procedures. NIST specifies the timing of the evaluation and provides a standardized questionnaire distributed to manufacturing firms served by MMEC. The analysis of the surveys and a written report are provided by an independent analyst.

Manufacturing clients are asked to evaluate the effectiveness of MMEC and to quantify the economic impact of MMEC's activities

on their business and its effects on the Montana economy. Clients are surveyed six months after a project is complete and asked about their satisfaction with the services they received. These respondents are also asked to quantify certain economic impacts and outcomes associated with the MMEC project. MMEC sent the independent analyst preparing this report the questionnaires for the 2020 evaluation period. After careful review, one was judged to be incomplete or otherwise unusable because none of the questions were answered. Consequently, there were 68 questionnaires in the 2020 evaluation. These questionnaires provided the largest sample size since the evaluations began, eclipsing the 63 responses in 2019.

OVERALL SATISFACTION

Manufacturing clients said they relied heavily on MMEC and were very satisfied with the services received. In 2020, about 37% percent of the respondents said they relied on external services (**Table 12**). This is a significant turnaround from 2019 when 27% of respondents relied on external services, likely due to challenges imposed by the pandemic.

Montana manufacturers were asked if they would recommend MMEC to other potential clients. They were asked to rate the likelihood of a positive recommendation with one being the least likely and 10 being the most likely. As shown in **Table 13**, about 90% of 2020 respondents chose a score of nine or 10. There were no scores of less than five. The net promoter score, which is the percent of respondents choosing nine or 10 minus the percent of respondents with scores of six or below is 86.8.

WHY CHOOSE MMEC

The NIST questionnaire provided eight reasons for choosing MMEC and the respondents were asked to identify the two most important. The 68 responses are reported in **Table 14**, with responses from 2019 for comparison.

About 68% of the respondents mentioned staff expertise of MMEC as the most important reason, slightly below responses in 2019. The second most important factor for firms choosing MMEC was the MMEC’s costs with about 34 % of the respondents mentioning this factor, down from 2019. Third is fair and unbiased advice, with 25% responding yes. Reputation for results rose to the fourth position, with 22% responding positively. Nineteen percent of respondents mentioned knowledge of the respondent’s industry, a significant jump from 2019.

Also experiencing a sizable positive response, 21% percent of respondents stated that MMEC provided specific knowledge that was not available from other providers, while only 6% responded that they used MMEC because no other nearby providers were available. Staff expertise remains the top reason for using MMEC services.

FUTURE CHALLENGES

The NIST questionnaire provided two opportunities for the respondents to identify future challenges they may face. The first opportunity instructed the respondents to pick three of nine categories of potential future challenges and the second was an open-ended question. Given the unique circumstances surrounding the COVID pandemic throughout this section, the report includes responses in 2019 as well.

Table 12. Have you used any external providers for business performance services?

	Frequency	Percent
No = 0	43	63%
Yes = 1	25	37%
Total	63	100%

Table 13. How likely would you be to recommend MMEC to other clients?

Response (1-10 scale)	Frequency	Percent	Cumulative
5	1	1.5%	1.5
6	2	1.5%	3
7	2	2.9%	5.9
8	3	4.4%	10.3
9	5	7.4%	17.7
10	56	82.4%	100
Total	68	100%	

Client Comments

The NIST questionnaire provides a number of opportunities for Montana manufacturers to provide suggestions and comments to MMEC. These responses were edited slightly to preserve anonymity and grouped by topic. These comments provide insight into the many ways manufacturers are benefited by MMEC services. The vast majority of the comments are highly positive and detailed. As in the past, respondents made several specific suggestions concerning ways in which MMEC may further tailor its services in the future.

Professionalism and Relevance

“The center has been a valuable resource over the past two decades for myself and Phillips Environmental Products.”

“I have always been impressed with the expertise and knowledge that MMEC has presented, as well as the willingness to work with so many companies to help improve their operational performance. I look forward to future projects and further results for our facility.”

“The newsletter is a great resource for connecting local manufacturers to one another. One really helpful thing is when new capabilities at a local manufacturer are spotlighted. This helps us to overcome the information barriers between companies and helps us build symbiotic business-to-business relationships.”

“It has been a fantastic addition to our current company setup. With the pandemic everything has changed, but before it has been very beneficial to educate us more about what others are doing in their companies.”

“Continue the great work to support the local manufacturing community. MMEC’s response to the COVID-19 crisis was outstanding.”

Suggestions for MMEC

“I would love to see more available from the center, or at least, I would like as we grow as a business to learn even more about the center to possibly increase our working relationship and utilize what they truly have to offer and above what we have to date. Thank you all!”

“It would be great if they prepared a brief class or materials to be used in an existing class that covered the basics of lean. This material would be used at MSU for the engineering students and at Gallatin College for the CNC students. Currently these students graduate with zero knowledge of lean, which leaves it to the employer to provide training.”

“Better follow-up after the next year or two. One expert involved from start to finish would help even if the other players might change. We weren’t able to build and maintain a relationship with one person and spent a lot of time catching the new person up.”

“More marketing! The services provided are amazing but you’re too quiet about them. It shouldn’t necessitate a personal conversation with MMEC staff to understand the scope of services offered. Foreign and domestic – we specialize!”

Table 14. Important factors for your firm choosing MMEC.

Factor	2019	2020
Center staff expertise	69.8%	67.6%
Cost price of services	36.5%	33.8%
Fair and unbiased advice services	25.4%	25.0%
Reputation for results	17.5%	22.1%
Knowledge of your industry	11.1%	19.1%
Specific services not available from other providers	7.9%	20.6%
Lack of other providers nearby	9.5%	5.9%
Other	11.1%	4.4%

As shown in **Table 15** in descending order of 2020 responses, with 2019 responses for comparison, the most often mentioned future challenges were ongoing continuous improvement/cost reduction strategies (71%). Employee recruitment and retention was second (54%) and product innovation/development was third (46%). The least mentioned were exporting/global engagement (7%) and technology needs (10%). Financing as a challenge jumped to 18% in 2020.

Since the beginning of the survey, the most important reported challenges have stayed relatively stable, with continuous improvement/cost reduction strategies consistently ranked among the top two challenges. Again in 2020, we see that this remains the top priority.

Several other challenges have risen or declined in importance over the business cycle. Personnel issues (employee recruitment and retention) has consistently climbed since 2009 and ranked second in 2020, giving further evidence of a tightening labor market. The COVID pandemic put more strain on employment, which is illustrated by the 10% increase since 2019. Closely following recruitment was product innovation with 46% identifying this as a concern, up from 43% in 2019. The global economy as a concern fell to 7.5%, roughly where it was in 2018. Again, reflecting some of the concerns surrounding the pandemic, financing concerns jumped to 18%, a 7% increase over 2019.

Despite the pandemic economy, Montana manufacturers reported that working with MMEC resulted in 310 new or retained jobs and over \$55 million in new or retained sales.

QUANTITATIVE ESTIMATES OF MMEC VISIT OUTCOMES

The NIST survey asked Montana manufacturers to quantify certain outcomes of the MMEC visit. They were asked the number of new and retained jobs, the amounts of cost savings, new and retained sales, capital and workforce investments and avoided unnecessary investments during the previous 12 months. Starting in 2009, the respondents were queried further about four detailed investment categories.

Table 16 shows the results for the 2020 responses to the quantitative outcomes. 2020 respondents said that there were 310 new or retained jobs as a result of working with MMEC. New and retained sales were about \$55.2 million. Cost savings totaled approximately \$10.3 million and capital and workforce investments were rough-

ly \$14.1 million. Avoided unnecessary investment totaled about \$2.4 million. The final column totals all the survey responses from 2013 to 2020.

ECONOMIC IMPACTS OF MMEC VISITS AND SERVICES

MMEC clients were queried about the number of new jobs created and the number of jobs retained as a result of working with MMEC. The 2020 respondents said that there were 76 new jobs created and 234 jobs retained for a total of 310 jobs.

The preliminary data suggest that average wages for Montana manufacturing jobs were about \$52,111 in 2020 – compared to the state average income of \$46,743 – up from \$51,666 in 2019. Total wages associated with the new and retained jobs were approximately \$16.2 million. Using an average tax rate of 4.95%, the new and retained workers paid approximately \$800,000 in Montana individual income taxes.

The Montana Department of Labor and Industry estimates that the employment multiplier of manufacturing is 3.58. This suggests that about 2.58 new jobs will be created in other

sectors as a result of one new manufacturing job. This agency also reports that the wage multiplier is 2.72, implying that an additional \$1.72 in wages is created elsewhere in the Montana economy for each \$1 in new manufacturing wages.

Calculations based on employment and wage multipliers are reported in **Table 17**. The 310 new and retained jobs associated with MMEC visits reported in 2020 led to a total of 1,110 ($310 \times 3.58 = 1,134.9$) new jobs in Montana and approximately \$43.9 million ($\$16.2 \text{ million} \times 2.72 = \43.9 million) in statewide wages. The additional wages generated roughly \$2.2 million ($\$43.9 \times .0495 = \2.2 million) in Montana individual income tax revenue.

RETURN ON INVESTMENT AND FEES

MMEC is a public-private partnership that was awarded \$649,000 in 2020 from the National Institute of Standards and Technology with a match requirement. In 2019, MMEC matched the federal funds with \$500,000 from the state of Montana and \$221,613 in project fees that were charged to Montana manufactures who re-

Table 15. Important future challenges facing your business.

Challenge	2019	2020
Ongoing continuous improvement cost reduction strategies	71.4%	70.6%
Employee recruitment and retention	46%	54.4%
Product innovation development	42.9%	45.6%
Identifying growth opportunities	36.5%	45.6%
Financing	11.1%	17.6%
Managing partners and suppliers	20.6%	16.2%
Sustainability in products and processes	20.6%	14.7%
Technology needs	12.7%	10.3%
Exporting/global engagement	12.7%	7.4%

Table 16. Total sales, costs, investments and jobs earned or saved in 2020.

	2019	2020	Total: 2013-20
Retain jobs amount	224	234	--
Create jobs amount	93	76	--
Total jobs saved/retained	317	310	3,351
Increase sales amount	\$10,869,000	\$20,783,401	--
Retain sales amount	\$28,322,000	\$34,461,801	--
Total sales increased/retained	\$39,191,000	\$55,245,202	\$575,246,263
Cost savings amount	\$6,122,654	\$10,297,945	\$60,290,771
Increased investment	\$3,908,600	\$4,226,000	\$11,650,995
Invest human capital	\$582,218	\$842,484	\$5,695,139
Invest plant or equipment	\$4,778,790	\$4,008,760	\$55,872,480
Invest information systems/software	\$463,566	\$637,971	\$4,940,062
Invest other areas	\$5,784,041	\$4,345,287	\$94,847,555
Avoid unnecessary investments	\$1,304,421	\$2,355,038	\$10,631,045

Table 17. Economic impacts of MMEC services, 2020.

Sector	Jobs	Wages	Montana individual income taxes
Manufacturing	310	\$16,154,410	\$799,643
Other industries	800	\$27,785,585	\$1,375,386
Total	1,110	\$43,939,995	\$2,175,030

MMEC's return on investment to the Montana taxpayer was 4.4 to 1. ROI for private firms was 82 to 1.

requested MMEC services. The benefits of these investments may be estimated by calculating a return on investment (ROI) for each.

The ROI for the state of Montana is calculated by comparing the estimated increase in Montana individual income tax payments associated with the reported jobs created or saved due to working with MMEC. The ROI for MMEC clients is estimated by comparing the cost savings, plus avoided unnecessary investment, plus a portion of the increased sales to the amount paid by clients.

As shown in **Table 17**, MMEC projects generated approximately \$2,175,030 in Montana individual income taxes from both direct and indirect jobs. Based on \$500,000 calendar year funding for MMEC, Montana's return on investment during 2020 was approximately 4.4 to 1 ($\$2,175,030 \div \$500 \text{ thousand} = 4.35$). Therefore, the public dollars invested in MMEC provide Montanans a considerable rate of return.

As presented in **Table 9**, MMEC clients reported \$10,297,945 in costs savings, \$2,355,038 in avoided unnecessary investments and \$55,245,202 in new or retained sales. Assuming a modest 10% gross margin, the net gain to clients of the new or retained sales was \$5,524,520 ($55,245,202 \times 0.1 = \5.5 million).

Cost savings + avoided investments + gross margin associated with new and retained sales equals \$18,177,503 ($\$10,297,945 + \$2,355,038 + \$5,524,520 = \18.2 million). Based on the \$221,613 in fees paid by MMEC clients, their return on investment in 2020 was approximately 82.0 to 1 ($\$18,177,503 \div \$221,613 = 82.0$). Therefore, the fees paid by MMEC clients similarly provide them an excellent return. This is a considerable ROI, however it comes with the caveat that 2020 was a unique year and it should be noted in previous years the adjusted cost savings was used in the ROI calculations, whereas this year the actual data is being used.



APPENDIX: EXPECTATIONS ABOUT THE FUTURE

Results of the 2020 manufacturing expectations survey are in **Table A1**. As the table shows, most Montana manufacturers were enthusiastic about 2020. Most (over 60%) expected the revenue side of

the balance sheet, production, sales and profits, to rise. Eighty percent anticipate a rise in costs. These responses led to an overall outlook that was positive for 59% of respondents.

Table A1. Expectations for the future.

Q12. Looking ahead to calendar year 2021, what do you anticipate will happen to your plant's production in 2021?

<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
8.5%	32.6%	58.9%	141

Q13. What do you anticipate will happen to the prices you receive for your plant's products in 2021?

<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
1.4%	28.1%	70.5%	139

Q14. What do you anticipate will happen to your plant's gross sales in 2021?

<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
9.3%	27.9%	62.9%	140

Q15. What do you anticipate will happen to your plant's profit in 2021?

<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
21.3%	30.5%	48.2%	141

Q16. Do you anticipate that major capital expenditures will be made in 2021?

<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
21.3%	30.5%	48.2%	141

Q17. What do you anticipate will happen to the number of employees in your plant in 2021?

<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
21.3%	30.5%	30.9%	141

Q18. What do you anticipate will happen to the cost of your major inputs in 2021?

<i>Decrease</i>	<i>Stay same</i>	<i>Increase</i>	<i>Total</i>
1.5%	19%	79.6%	278

Q20. Considering all factors, how would you rate the overall outlook for your plant for 2020?

<i>Worse</i>	<i>Same</i>	<i>Better</i>	<i>Total</i>
13%	28.3%	58.7%	278



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