The Bishop Report
Performance and Forecast of the World Connector Industry

Issue No. 334 | 3rd Quarter 2020 | September 2020

Industry Sales Accelerate in August, Up +8.4% over the Prior Month

Regional Performance:
Worldwide month-over-month connector sales rose for the fourth consecutive month in August. Europe's sales grew the most (+11.0%), followed by North America (10.6%), and ROW (+9.4%).

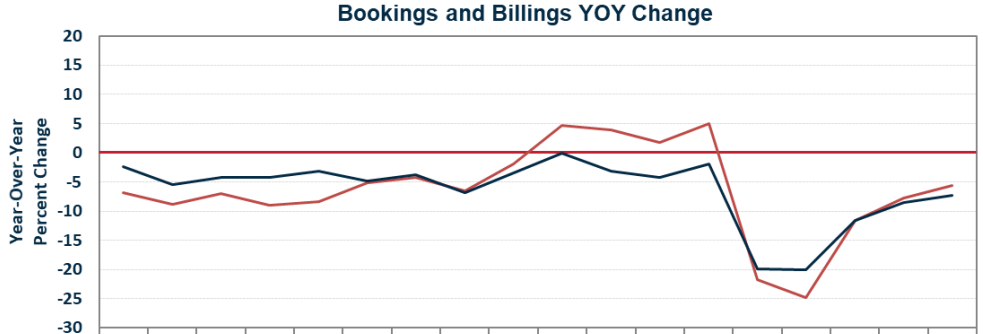
Currency Impact:
Year-to-date, the euro and the yuan declined in value against the US dollar. In local currencies, world connector sales were down -8.8% versus -9.6% measured in US dollars.

How's Business? OEM
COVID-19 lockdowns put downward pressure on sales in most markets except for Semiconductor (+14.3%), Instrumentation (+4.6%), and Military/Aerospace (+2.0%). Transportation (-31.9%) and Automotive (-25.5%) suffered the greatest declines.

12 Trends
The sixth installment of the connector technology trends covers copper to optical connectivity.

August 2020 **billings** dropped -7.3%, year-over-year. Sequentially, orders and sales for the month both ticked up, +10.1% and +8.4%, respectively. August 2020 **bookings** declined -5.6% over the same month in the prior year. The connector industry sales accelerated month-over-month in August as COVID-19 cases declined in North America and China's recovery continued.

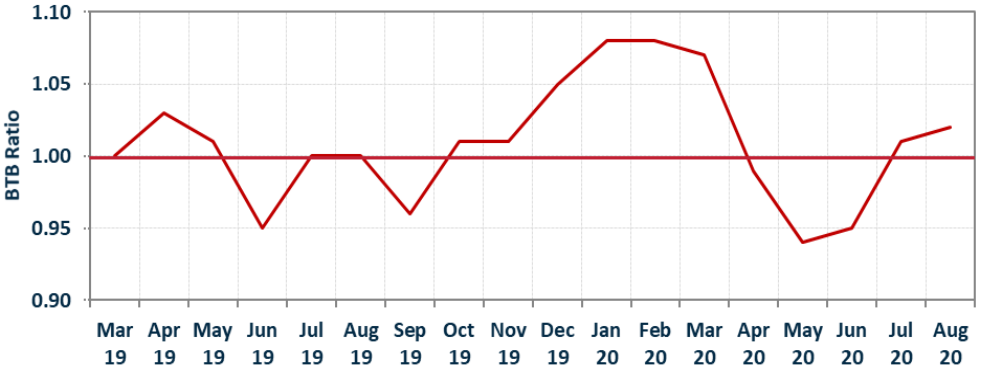
Bookings and Billings YOY Change



	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Jul 20	Aug 20
Bookings	-6.8	-8.8	-7.0	-9.0	-8.4	-5.2	-4.3	-6.6	-1.9	4.6	3.9	1.8	5.0	-21.8	-24.8	-11.6	-7.8	-5.6
Billings	-2.4	-5.4	-4.3	-4.2	-3.1	-4.9	-3.7	-6.9	-3.4	-0.1	-3.1	-4.3	-2.0	-19.9	-20.0	-11.6	-8.5	-7.3

The book-to-bill ratio rose to 1.02 as orders outpace sales in August.

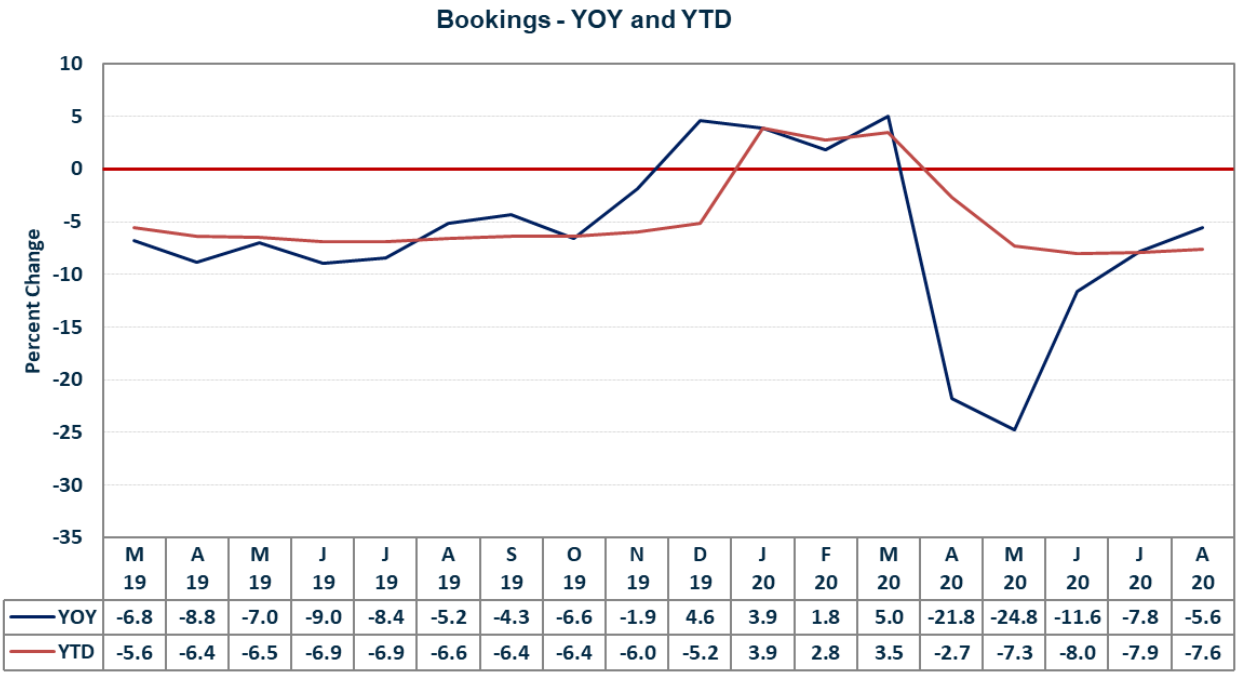
Connector Industry Book-to-Bill



Booking Highlights and Conclusions

Sequential, Year-Over-Year, and Year-To-Date Bookings Percentage Change – 2018/2019/2020

	Sequential			Year-Over-Year			Year-To-Date		
Month	2018	2019	2020	2018	2019	2020	2018	2019	2020
Jan	2.8%	1.0%	0.2%	15.5%	-3.7%	3.9%	15.5%	-3.7%	3.9%
Feb	10.6%	7.7%	5.5%	17.5%	-6.2%	1.8%	16.5%	-5.0%	2.8%
Mar	-3.8%	-4.5%	-1.4%	17.7%	-6.8%	5.0%	16.9%	-5.6%	3.5%
Apr	-0.2%	-2.2%	-27.2%	17.7%	-8.8%	-21.8%	17.1%	-6.4%	-2.7%
May	4.9%	6.9%	2.9%	15.7%	-7.0%	-24.8%	16.8%	-6.5%	-7.3%
Jun	-7.0%	-8.9%	7.0%	10.6%	-9.0%	-11.6%	15.8%	-6.9%	-8.0%
Jul	-0.1%	2.8%	7.4%	11.8%	-8.4%	-7.8%	15.2%	-6.9%	-7.9%
Aug	6.4%	7.8%	10.1%	7.1%	-5.2%	-5.6%	14.1%	-6.6%	-7.6%
Sep	-7.9%	-7.1%		0.7%	-4.3%		12.5%	-6.4%	
Oct	3.0%	0.6%		6.8%	-6.6%		11.9%	-6.4%	
Nov	5.5%	10.8%		-0.3%	-1.9%		10.5%	-6.0%	
Dec	-13.6%	-7.8%		-2.0%	4.6%		9.6%	-5.2%	



	M 19	A 19	M 19	J 19	J 19	A 19	S 19	O 19	N 19	D 19	J 20	F 20	M 20	A 20	M 20	J 20	J 20	A 20
YOY	-6.8	-8.8	-7.0	-9.0	-8.4	-5.2	-4.3	-6.6	-1.9	4.6	3.9	1.8	5.0	-21.8	-24.8	-11.6	-7.8	-5.6
YTD	-5.6	-6.4	-6.5	-6.9	-6.9	-6.6	-6.4	-6.4	-6.0	-5.2	3.9	2.8	3.5	-2.7	-7.3	-8.0	-7.9	-7.6

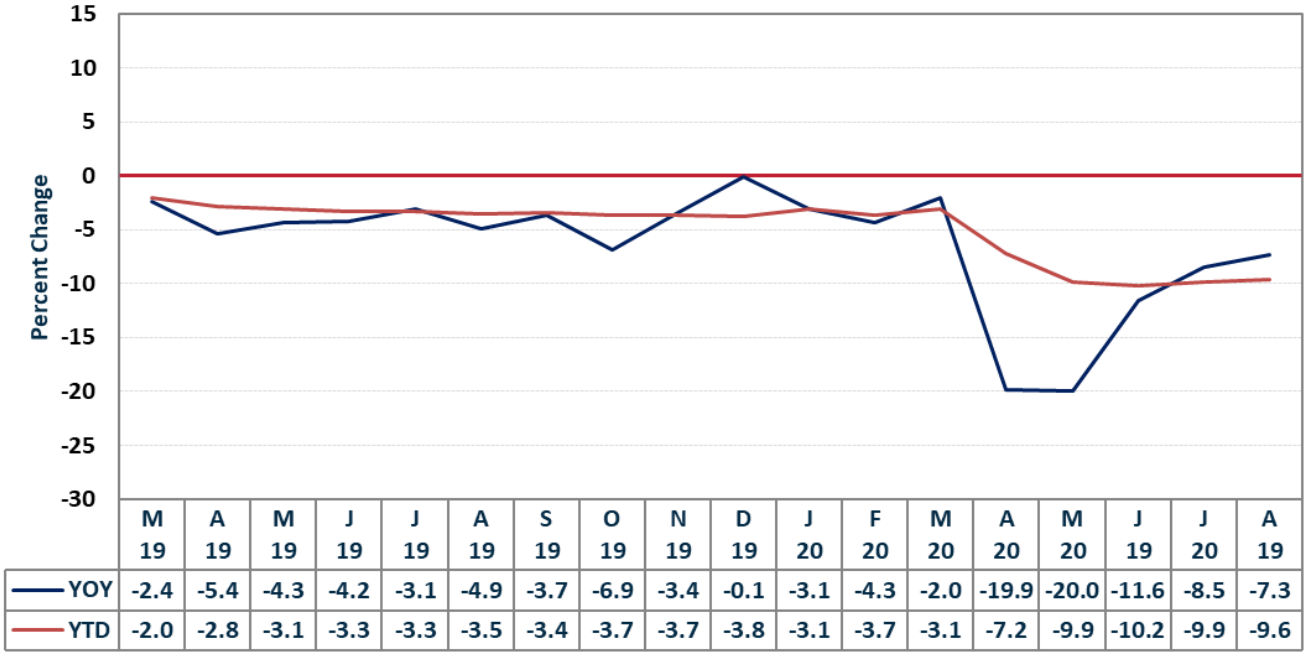
- August bookings fell -5.6% year-over-year (YOY).
- Orders contracted -7.6% year-to-date (YTD).
- Sequentially, orders rose +10.1% over the prior month.
- The book-to-bill ratio for August increased to 1.02.
- Year-to-date, the book-to-bill ratio remained at 1.02.

Billing Highlights and Conclusions

Sequential, Year-Over-Year, and Year-To-Date Billings Percentage Change – 2018/2019/2020

	Sequential			Year-Over-Year			Year-To-Date		
Month	2018	2019	2020	2018	2019	2020	2018	2019	2020
Jan	2.9%	0.3%	-2.8%	17.2%	-1.0%	-3.1%	17.2%	-1.0%	-3.1%
Feb	8.4%	6.8%	5.5%	15.6%	-2.5%	-4.3%	16.2%	-1.8%	-3.7%
Mar	-3.2%	-3.2%	-0.9%	14.8%	-2.4%	-2.0%	15.8%	-2.0%	-3.1%
Apr	-2.3%	-3.7%	-21.2%	15.7%	-5.4%	-19.9%	15.7%	-2.8%	-7.2%
May	7.8%	9.0%	8.8%	13.2%	-4.3%	-20.0%	15.1%	-3.1%	-9.9%
Jun	-4.4%	-4.2%	5.8%	14.9%	-4.2%	-11.6%	15.1%	-3.3%	-10.2%
Jul	-3.1%	-2.0%	1.4%	10.5%	-3.1%	-8.5%	14.4%	-3.3%	-9.9%
Aug	9.0%	7.0%	8.4%	9.4%	-4.9%	-7.3%	13.7%	-3.5%	-9.6%
Sep	-4.1%	-2.9%		9.0%	-3.7%		13.2%	-3.4%	
Oct	-0.8%	-4.1%		7.6%	-6.9%		12.6%	-3.7%	
Nov	6.7%	9.8%		4.1%	-3.4%		11.7%	-3.7%	
Dec	-14.2%	-11.2%		1.6%	-0.1%		11.0%	-3.8%	

Billings - YOY and YTD



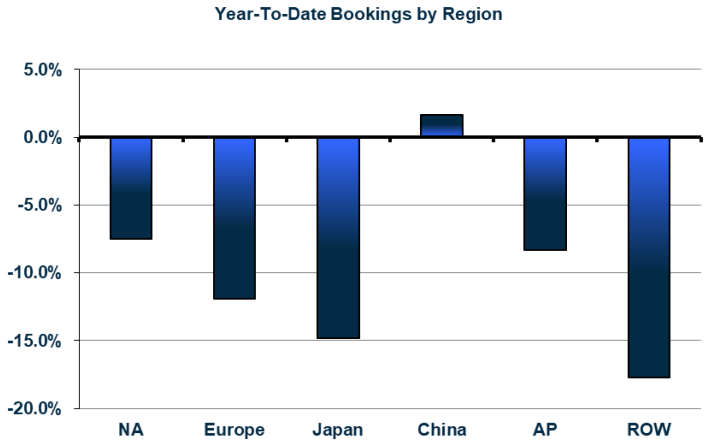
	M 19	A 19	M 19	J 19	J 19	A 19	S 19	O 19	N 19	D 19	J 20	F 20	M 20	A 20	M 20	J 19	J 20	A 19
YOY	-2.4	-5.4	-4.3	-4.2	-3.1	-4.9	-3.7	-6.9	-3.4	-0.1	-3.1	-4.3	-2.0	-19.9	-20.0	-11.6	-8.5	-7.3
YTD	-2.0	-2.8	-3.1	-3.3	-3.3	-3.5	-3.4	-3.7	-3.7	-3.8	-3.1	-3.7	-3.1	-7.2	-9.9	-10.2	-9.9	-9.6

- Billings decreased -7.3% YOY in August.
- Year-to-date sales were down -9.6%.
- Sequential billings grew +8.4%.

Regional Performance

August 2020 Bookings

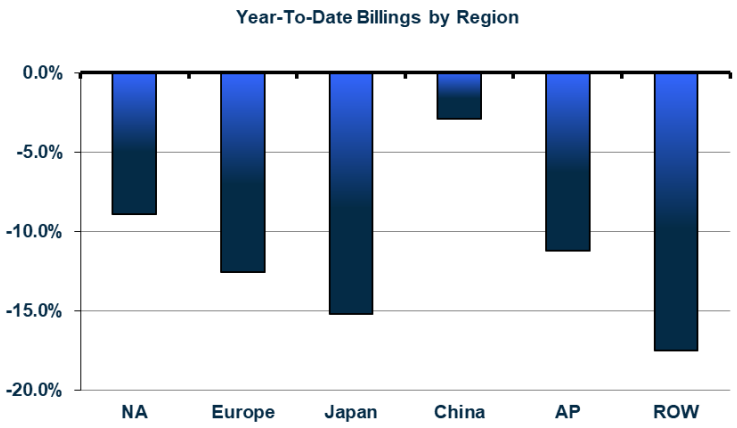
Region	Sequential	YOY	YTD
NA	18.0%	-4.7%	-7.5%
Europe	1.0%	-5.8%	-11.9%
Japan	19.0%	-20.1%	-14.8%
China	15.5%	2.8%	1.7%
AP	4.9%	-10.3%	-8.3%
ROW	-4.1%	-21.2%	-17.7%
Total	10.1%	-5.6%	-7.6%



- August bookings decreased -5.6% YOY. August orders grew +10.1% over the previous month.
- Year-over-year orders declined in all regions except China which increased +2.8%. ROW, Japan, and Asia Pacific exhibited double-digit declines, down -21.2%, -20.1%, and -10.3 respectively.
- Highlights for the month include sequential growth in five of the six regions, with double-digit growth in Japan (+19.0%), North America (+18.0%), and China (+15.5%).
- Sequentially, ROW declined -4.1%.
- This is the fourth consecutive month of connector industry sequential bookings growth. August orders are down -6.5% from their pre-COVID levels (February, 2020), a +1.5% improvement over the prior month.
- The 10.1% sequential total world bookings increase was the highest since November 2019, two months before the first recorded COVID-19 case in the West.

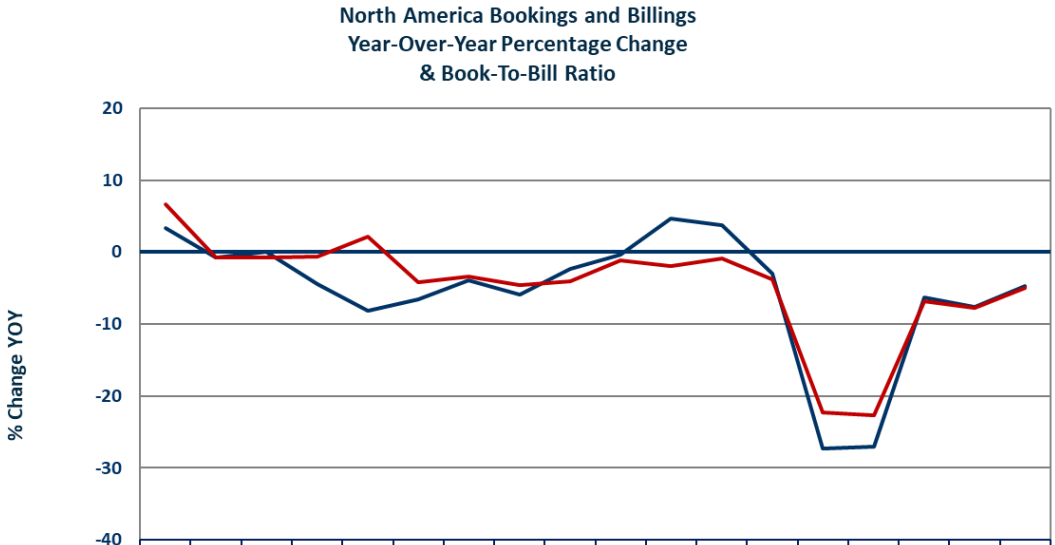
August 2020 Billings

Region	Sequential	YOY	YTD
NA	10.6%	-5.0%	-8.9%
Europe	11.0%	-5.4%	-12.5%
Japan	6.6%	-22.1%	-15.2%
China	5.1%	-3.7%	-2.9%
AP	5.0%	-12.2%	-11.2%
ROW	9.4%	-16.2%	-17.5%
Total	8.4%	-7.3%	-9.6%



- Worldwide connector sales increased sequentially +8.4%, with all regions exhibiting positive month-over-month sales growth.
- Europe saw the largest increase in sales month-over-month in August, up +11.0% followed closely by North America, up +10.6%.
- YOY sales declined in double-digits in Japan (-22.1%), ROW (-16.2%), and Asia Pacific (-12.2%).
- Year-to-date, billings were down -9.6%, up +0.3% from July. Sales in Europe, Japan, Asia Pacific, and ROW were down double-digits, YTD. China, the region with the strongest recovery, was down -2.9% YTD in July.
- Worldwide connector sales in August were only -1.2% below their pre-COVID levels (February, 2020).
- 2020 total connector industry sales forecast is for a -9.4% decline YOY.

North America: The following chart displays the year-over-year percentage change in bookings and billings for the last 18 months. The monthly book-to-bill (BTB) ratio is also displayed.



	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Jul 20	Aug 20
Bookings YOY	3.3	-0.7	0.0	-4.5	-8.2	-6.6	-3.9	-5.9	-2.3	-0.3	4.7	3.8	-3.0	-27.3	-27.0	-6.3	-7.6	-4.7
Billings YOY	6.6	-0.7	-0.8	-0.6	2.1	-4.2	-3.4	-4.6	-4.1	-1.2	-2.0	-0.9	-3.8	-22.3	-22.7	-6.8	-7.8	-5.0
Billings SEQ	-4.6	-4.9	10.4	-5.1	1.3	7.2	-7.7	-3.1	7.1	-8.1	-4.1	13.7	-7.4	-23.2	9.8	14.5	0.2	10.6
BTB	1.05	1.06	0.98	0.96	0.93	0.99	0.96	1.01	1.00	1.02	1.11	1.09	1.06	0.99	1.01	0.97	0.93	0.99

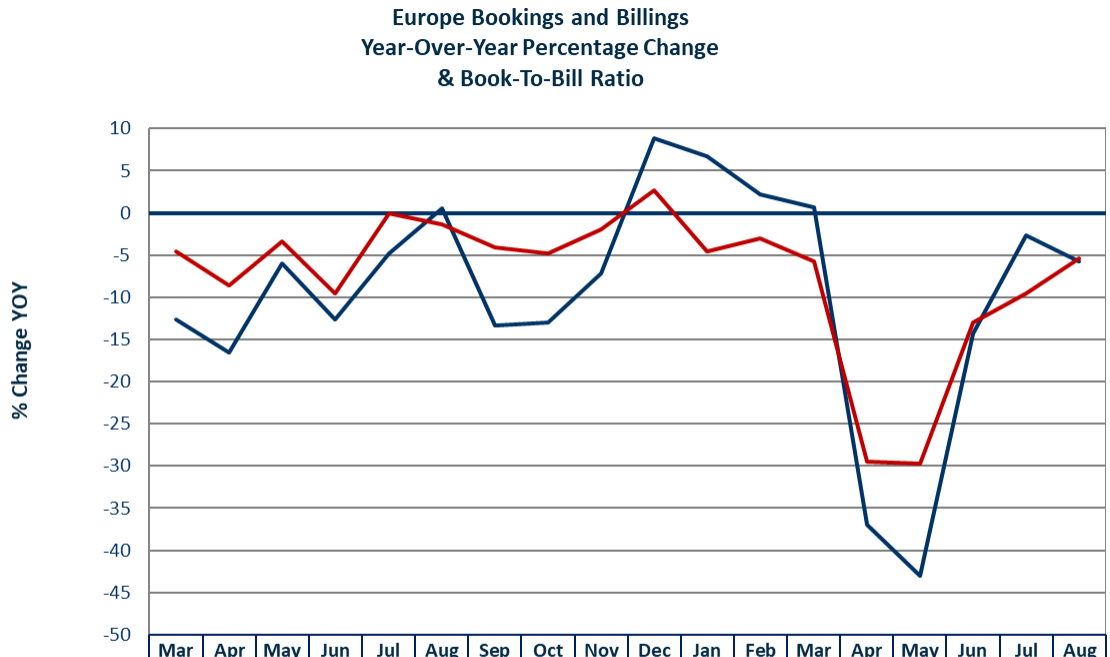
North America Performance

- Sales dropped -5.0% and orders declined -4.7% YOY in August.
- Industrial production fell 7.2% YOY but increased 0.4% sequentially in August.
- Unemployment in the US fell to 8.4% in August from 10.2% in July. The number of unemployed fell by 2.8 million to 13.6 million. The unemployment rate was 6.7% above pre-COVID-19 February 2020 levels.
- Retail sales in the United States increased 2.6% in August YOY. Sequentially, retail sales climbed 0.6%.
- August automotive sales were down 11% versus a year ago.
- The two-week average in COVID-19 cases was up 75.5% and deaths decreased 12.7%. (World average cases decreased 1.8%, deaths decreased 16.5%.) Data as of September 22, 2020. Source: https://www.statnews.com/feature/coronavirus/covid-19-tracker/

Conclusions

North American connector sales in August were down -1.0% from their pre-COVID crisis level (February 2020). This is the best performing region based on this metric. In August, connector sales in North America, despite political and economic uncertainities, on a sequential bases, out-preformed all regions but Europe. It is unlikely that the US will see substantial fiscal support with November elections potentially being contested and challenged in the courts. Bishop forecasts full year 2020 to be down -8.7%.

Europe: The following chart displays the year-over-year percentage change in bookings and billings for the last 18 months. The monthly book-to-bill ratio is also displayed.



	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Jul 20	Aug 20
Bookings YOY	-12.6	-16.6	-6.0	-12.6	-4.8	0.5	-13.3	-13.0	-7.2	8.8	6.7	2.2	0.7	-37.0	-43.0	-14.3	-2.7	-5.8
Billings YOY	-4.6	-8.6	-3.4	-9.5	-0.1	-1.4	-4.1	-4.8	-1.9	2.7	-4.6	-3.0	-5.8	-29.5	-29.7	-13.0	-9.6	-5.4
Billings SEQ	-8.9	-5.4	14.7	-12.8	1.8	6.0	-4.3	-1.9	9.9	-22.0	13.5	13.9	-11.5	-29.2	14.3	8.0	5.9	11.0
BTB	1.00	0.99	1.05	0.98	1.02	1.00	0.90	0.96	0.99	1.14	1.08	1.05	1.07	0.88	0.85	0.97	1.10	1.00

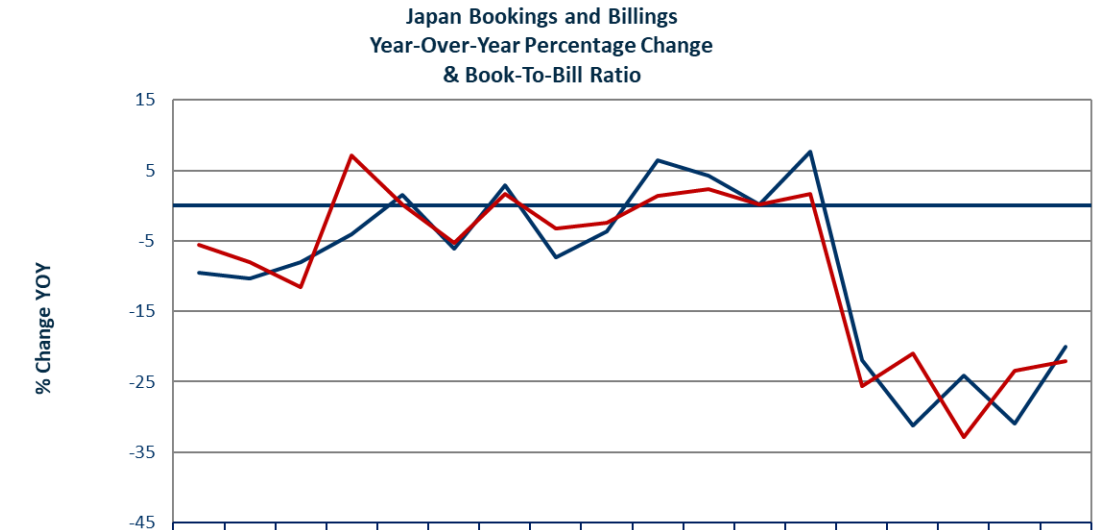
Europe Performance

- YOY billings declined -5.4%, while orders dropped -5.8% and the book-to-bill ratio was 1.00. Sequentially, sales increased +11.0% making this region is fasting grow region by this metric.
- Industrial production contracted 7.7% YOY in July, up 4.1% month-over-month. In the UK, industrial production shrank 7.8% YOY, while it grew 5.2% month-over-month.
- Retail sales rose 0.4% YOY in July but dipped 1.3% month-over-month.
- Euro area car registrations contracted 32.0% year-over-year in the first eight months of 2020. August was down 18.9% YOY with the largest declines recorded in Germany (-20.0%).
- Business confidence rose to -1.33 points in August, slightly better than the -1.8 recorded the prior month. The IHS Markit Eurozone Manufacturing PMI increased to 53.7 in September 2020, the largest since February 2018.
- COVID-19 cases in Germany increased 32.5% and deaths declined 55.2% (two-week average change). Source: https://www.statnews.com/feature/coronavirus/covid-19-tracker/ as of September 23, 2020.

Conclusions

Europe faces a likely slowdown in the coming months as COVID-19 cases rise, and they start targeted lockdowns. Fears of a no-deal Brexit could impact sales growth. Connector sales in Europe were still -9.1% below pre-COVID lockdown levels (February 2020). Bishop forecasts full year 2020 to be down -14.2%.

Japan: The following chart displays the year-over-year percentage change in bookings and billings for the last 18 months. The monthly book-to-bill ratio is also displayed.



	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Jul 20	Aug 20
Bookings YOY	-9.6	-10.4	-8.0	-4.1	1.5	-6.1	2.9	-7.4	-3.6	6.5	4.3	0.2	7.6	-22.0	-31.2	-24.2	-31.0	-20.1
Billings YOY	-5.6	-8.0	-11.6	7.1	0.2	-5.3	1.6	-3.3	-2.4	1.4	2.4	0.2	1.6	-25.7	-21.0	-32.8	-23.4	-22.1
Billings SEQ	-4.9	-2.1	-0.9	20.5	-14.4	4.7	4.4	-10.7	10.8	-7.2	-6.5	12.1	-3.6	-25.7	1.8	2.4	-2.4	6.6
BTB	0.97	1.02	0.99	0.86	1.01	0.99	0.97	0.99	1.00	1.09	0.97	1.00	1.03	1.04	0.87	0.97	0.91	1.02

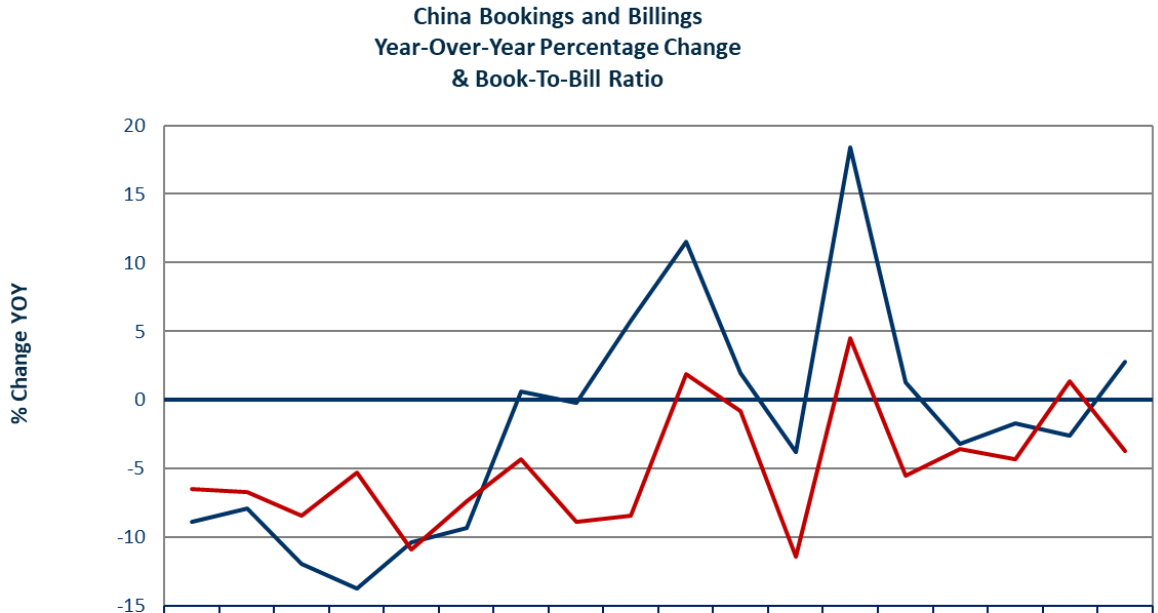
Japan Performance

- Japan's book-to-bill ratio rose to 1.02 in August. Bookings and billings both declined further in August, -20.1% and -22.1%, respectively. On a sequential basis, Japan's sales rose +6.6%.
- Industrial production declined 15.5% YOY but increased 8.7% on a month-over-month basis in July.
- July 2020 retail sales fell 2.8% YOY and sequentially 3.3%.
- The unemployment rate edged up to 2.9% in July 2020, compared to 2.8% in the prior month.
- Exports slumped 14.8% YOY in July, the 21st straight month of decline in exports. Exports to the US declined 21.3%, while sales to China climbed 5.1%. The manufacturing PMI ticked up to 47.3 in September versus 47.2 in the previous month.
- Business sentiment (-34) plunged to an eleven-year low in July.
- COVID-19 cases in Japan declined 20.5% and deaths decreased 33.0% (two-week average change). Source: https://www.statnews.com/feature/coronavirus/covid-19-tracker/ as of September 23, 2020.

Conclusions

Japan connector sales in August were down -22.4% from their pre-COVID crisis level (February 2020), a 4.8% improvement over the prior month. Japan faces great uncertainty after the longest serving Prime Minister resigns due to personal health issues. Yoshihide Suga was named the interim Prime Minister. Bishop forecasts 2020 connector sales and booking for this region to remain negative, down 15.9% for the year.

China: The following chart displays the year-over-year percentage change in bookings and billings for the last 18 months. The monthly book-to-bill ratio is also displayed.



	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Jul 20	Aug 20
Bookings YOY	-8.9	-7.9	-11.9	-13.7	-10.4	-9.3	0.6	-0.2	5.8	11.5	2.0	-3.8	18.4	1.3	-3.2	-1.7	-2.6	2.8
Billings YOY	-6.5	-6.7	-8.4	-5.3	-10.9	-7.4	-4.3	-8.9	-8.4	1.9	-0.8	-11.4	4.5	-5.5	-3.6	-4.3	1.4	-3.7
Billings SEQ	6.6	-2.9	5.4	1.1	-8.0	10.7	1.2	-2.6	6.8	-0.7	-11.2	-15.0	25.8	-12.2	7.6	0.3	-2.5	5.1
BTB	0.97	1.02	0.97	0.90	1.04	1.03	1.02	1.03	1.08	0.99	1.07	1.12	1.09	1.10	0.97	0.92	1.00	1.10

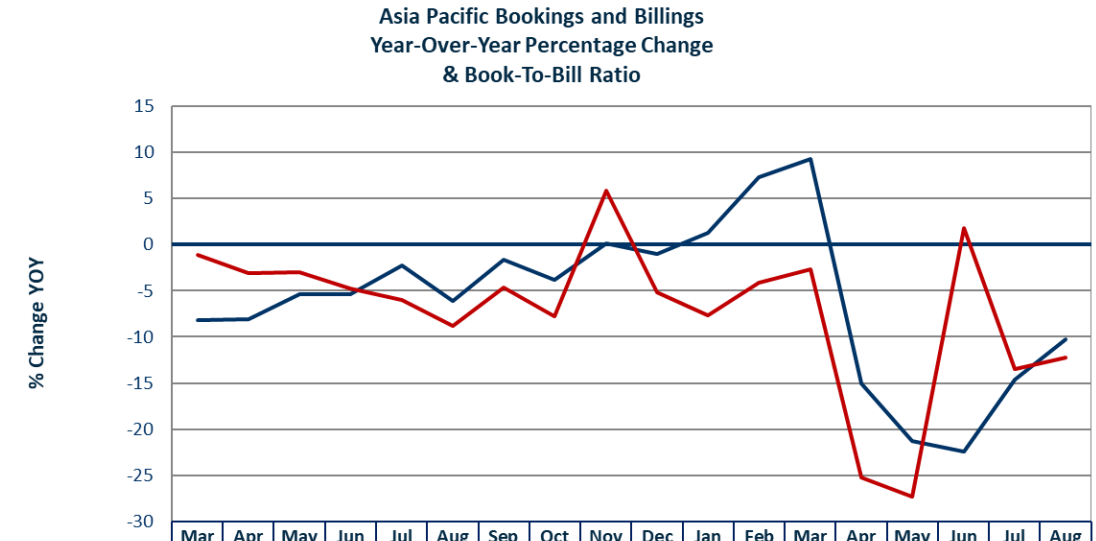
China Performance

- Sales year-over-year decreased -3.7% while orders increased +2.8%. The BTB was 1.10. On a sequential basis, sales rose +5.1%.
- Industrial production increased 5.6% YOY in August, the highest increase since December 2019. Electrical machinery climbed 15.1%, computer, communications, and electronic equipment rose 8.7% YOY.
- Retail sales grew 0.5% YOY in August. This is the first increase in seven months. Retail sales increased 1.25% in August 2020 versus the prior month.
- China's auto sales in August grew for the fifth successive month, up 11.6% YOY to 2.186 million units.
- Exports rose 9.5% YOY in August, after a 7.2% increase, in the previous month. August imports unexpectedly dropped by 2.1%, the market expected a slight gain. China's trade surplus with the United States widened to $34.24 billion.
- In China, the two-week change in COVID-19 cases and deaths declined 12.4% and 81.8%, respectively. Source: https://www.statnews.com/feature/coronavirus/covid-19-tracker/ as of September 23, 2020.

Conclusions

China connector sales in August were down -7.8% from their pre-COVID crisis level (November 2019). Bishop anticipates connector sales in China to contract 2.9% in 2020, making China the most resilient region.

Asia Pacific: The following chart displays the year-over-year percentage change in bookings and billings for the last 18 months. The monthly book-to-bill ratio is also displayed.



	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Jul 20	Aug 20
Bookings YOY	-8.2	-8.1	-5.4	-5.4	-2.3	-6.1	-1.6	-3.8	0.1	-1.0	1.3	7.3	9.3	-15.0	-21.3	-22.4	-14.6	-10.3
Billings YOY	-1.1	-3.1	-3.0	-4.7	-6.0	-8.8	-4.6	-7.8	5.9	-5.2	-7.7	-4.1	-2.7	-25.2	-27.3	1.8	-13.5	-12.2
Billings SEQ	-1.4	-0.3	6.3	-6.3	2.4	3.5	-1.6	-3.3	21.8	-16.2	-8.9	4.6	0.0	-13.7	3.0	-2.3	4.0	5.0
BTB	1.05	0.98	0.99	1.00	1.03	0.99	1.00	1.03	0.95	1.04	1.08	1.11	1.11	0.98	0.96	0.91	1.02	1.01

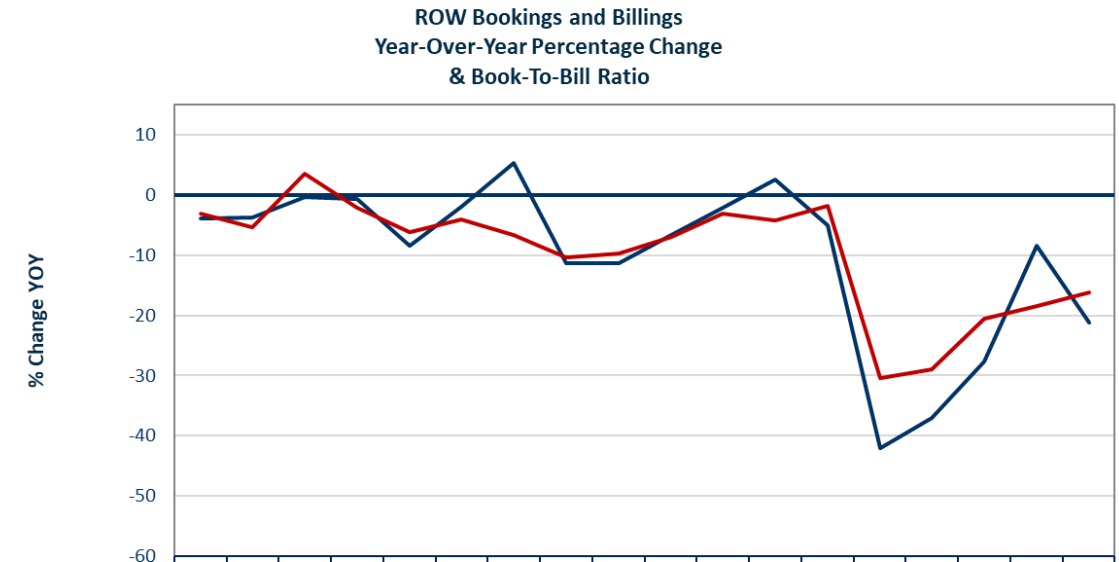
Asia Pacific Performance

- Orders declined -10.3% in August and sales dropped, down -12.2% YOY. The book-to-bill ratio was 1.01. Sequentially, sales in August grew +5.0%.
- India: In July, industrial production contracted 10.4% YOY. On a month-on-month basis, industrial production increased 8.4%. Manufacturing production in July decreased 11.1%. India's trade deficit narrowed to $6.77 billion in August from $13.86 billion a year earlier, and exports fell 12.7%.
- South Korea: Industrial production contracted 2.5% YOY and rose 1.6% over the previous month in July. Exports in South Korea fell 9.9% in August from a year earlier. Exports on displays were down 22.8%, general machinery down 17.1%, while computers spiked up 106.6%, the 11th straight month of growth. Consumer appliances advanced 14.9%.The manufacturing PMI increased to 48.5 in August from 46.9 in July.
- India's two-week change in COVID-19 cases rose 8.8%, while deaths dropped 5.8%.
- South Korea's two-week change in COVID-19 cases fell 51.0%, while deaths rose 37.5%. Source: https://www.statnews.com/feature/coronavirus/covid-19-tracker/ as of September 24, 2020.

Conclusions

Asia Pacific connector sales in August were down -7.8% from their pre-COVID crisis level (February 2020). Multinational corporations are looking to the region to build additional manufacturing, including Hyundai Motors which announced plans to build a new plant in Vietnam. This will shift some connector market share from China to other countries in this region. Bishop forecasts 2020 connector sales in the Asia Pacific region to be down -10.9% YOY.

Rest of World: The following chart displays the year-over-year percentage change in bookings and billings for the last 18 months. The monthly book-to-bill ratio is also displayed.



	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19	Jan 20	Feb 20	Mar 20	Apr 20	May 20	Jun 20	Jul 20	Aug 20
Bookings YOY	-3.9	-3.8	-0.4	-0.6	-8.4	-2.0	5.3	-11.4	-11.4	-6.6	-2.1	2.6	-5.1	-42.1	-37.1	-27.7	-8.5	-21.2
Billings YOY	-3.1	-5.3	3.5	-2.2	-6.2	-4.1	-6.7	-10.3	-9.7	-7.0	-3.1	-4.3	-1.8	-30.5	-28.9	-20.5	-18.4	-16.2
Billings SEQ	-6.2	0.1	8.3	-4.9	2.7	6.5	-4.5	-4.5	6.1	-10.2	-9.6	10.7	-5.5	-25.0	10.9	6.3	5.4	9.4
BTB	1.11	1.04	1.00	1.06	0.98	1.03	0.94	0.95	1.00	1.04	1.17	1.14	1.06	0.86	0.88	0.96	1.10	0.96

Rest of World Performance

- Bookings fell -21.2%, and billings declined -16.2% YOY in August. ROW is the worst-performing region year-to-date in 2020 (-17.5%). Sequentially, sales in the region grew +9.4%. The book-to-bill ratio slid to 0.96.
- Russia's industrial production dropped 7.2% YOY in August. Exports fell 2.1% in July. The country's trade surplus narrowed further to $4.25 billion in July, from $11.05 billion in the same period in 2019. The inflation rate increased to 3.6% YOY in July. (Bank of Russia inflation target is 4.0%). The unemployment rate increased slightly to 6.6% in August from 6.3% the previous month.
- Brazil's industrial production was down 3.0% YOY in July, while it increased 8.0% over the prior month. Retail sales increased 5.5% in July YOY and increased 5.2% over the previous month. The inflation rate rose to 2.44% in August. The manufacturing PMI continued its rise in August, increasing to 64.7 from 58.2 in July.
- Russia's two-week change in COVID-19 cases and deaths rose 15.5% and 13.7%, respectively.

  Brazil's two-week change in COVID-19 cases and deaths decreased 12.8% and 2.2%, respectively. Source: https://www.statnews.com/feature/coronavirus/covid-19-tracker/ as of September 24, 2020.

Conclusions

Rest of the World connector sales in July were down -3.7% from their pre-COVID crisis level (February 2020), an improvement of +8.3% over the prior month. Economic data in the region continue to improve while cases and deaths of COVID-19 are mixed, with declines in Brazil and increases in Russia. Despite these improvements, Bishop forecasts 2020 connector sales to decline -17.9%, making this the worst performing region.

August 2020 YTD Currency Impact on Regional Industry Growth

The euro and the Chinese yuan continued their decline in value against the US dollar. The Japanese yen rose 1.5% YTD in August. The following table measures the impact for August 2019 versus August 2020 and shows the YTD results for these three currencies.

Local Currency to One USD
YTD August 2019 versus August 2020

Currency	2019	2020	% Change
Euro	0.8870	0.8952	-0.9%
Yuan	6.8300	7.0183	-2.7%
Yen	109.3310	107.7316	1.5%

Europe, China, and Japan account for approximately 60% of world connector sales. Currency fluctuation to the US dollar can have a significant impact on our reporting of sales performance in US dollars.

The following table shows year-to-date sales performance by region in US dollars and local currencies.

Industry Sales Performance
August YTD 2020
USD-vs-Local Currencies

Region	U.S.$	Local Currency
North America	-8.9%	-8.9%
Europe	-12.5%	-11.7%
Japan	-15.2%	-16.4%
China	-2.9%	-0.2%
Asia Pacific	-11.2%	-11.2%
ROW	-17.5%	-17.5%
World	**-9.6%**	**-8.8%**

Connector sales are 1.2 percentage points higher when stated in local currencies rather than in US dollars, putting industry performance at -8.8% YTD in August (versus -9.6% YTD in US dollars).

In some regions, there is a larger discrepancy in the value of the US dollar to the local currency, e.g. Korean won. These regions are listed in the following table.

Local Currency to One USD
August YTD 2019 versus August 2020

Currency	2019	2020	% Change
Swiss Franc	0.9955	0.9551	4.2%
S. K. Won	1157.0854	1202.5941	-3.8%
Russian Ruble	65.1159	70.3268	-7.4%
Taiwan Dollar	31.0300	29.8463	4.0%
Indian Rupee	70.0127	74.3707	-5.9%
Singapore Dollar	1.3629	1.3931	-2.2%

How's Business? OEM

Bishop & Associates tracks sales and profits of 13 market sectors and more than 120 companies. The objectives are to determine how selected electronic markets have performed, identify sales and profit trends for forecasting purposes, and monitor company performance within market sectors.

The following tables provide the 2018/2019 percent change in revenues, and the first half 2020 versus the first half 2019 sales and percent change in sales by market sector.

Market Sector	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Telecom/Datacom	-2.9%	$175,075.9	$166,758.3	-4.8%
Automotive	-1.6%	$796,493.3	$593,279.0	-25.5%
Industrial	-7.3%	$199,617.8	$154,994.7	-22.4%
Mil/Aero	8.0%	$153,604.6	$156,705.6	2.0%
Computers	0.0%	$182,048.8	$177,209.2	-2.7%
Peripherals	-11.2%	$33,846.6	$31,964.0	-5.6%
Consumer	1.0%	$168,636.4	$154,638.2	-8.3%
Transportation	-5.2%	$169,158.7	$115,246.5	-31.9%
Medical	-0.2%	$51,435.5	$45,839.0	-10.9%
Instrumentation	4.9%	$22,251.3	$23,278.0	4.6%
Semiconductors	-16.3%	$124,024.3	$141,784.1	14.3%
CEMs	3.0%	$36,189.5	$32,967.3	-8.9%
Distribution	-4.6%	$31,660.9	$30,822.7	-2.6%

$ Millions

Ten of the 13 market sectors Bishop tracks had year-over-year sales declines during the first half of 2020. This quarter reflects the impact that the coronavirus lockdowns had on these industries throughout the second half of the year. Transportation experienced the steepest decline in sales, with the commercial aviation market hit especially hard. Automotive fell 25.5%, followed by industrial, down 22.4%, on year-over-year basis through the second quarter of 2020.

Semiconductor, Instrumentation, and Military/Aerospace grew in first half, up 14.3%, 4.6%, and 2.0%, respectively.

The aggregate decline for all reported industries was 14.9% YOY and down 14.3% 2Q20 versus 1Q20.

As a note: This database is not static. Companies are acquired or go into bankruptcy; thus, their financial data is no longer available, and they are removed from the database. These types of activities occur frequently, and because of this, as well as additions we have made to the database, it is not possible to directly compare current numbers to numbers referenced in past Bishop "How's Business? OEMs" reports. These analyses are meant to be used as a relative measure of market sector performance. If you have any questions about this database or specific market sectors, please feel free to contact us.

Also, when revenue increases or decreases more than 35% and net income more than 200% for a company, an explanatory footnote is provided. Many companies' manufacturing facilities were deemed nonessential and were thus closed for the month of April and much of May.

The following pages display each market sector in detail, including the companies selected for each sector.

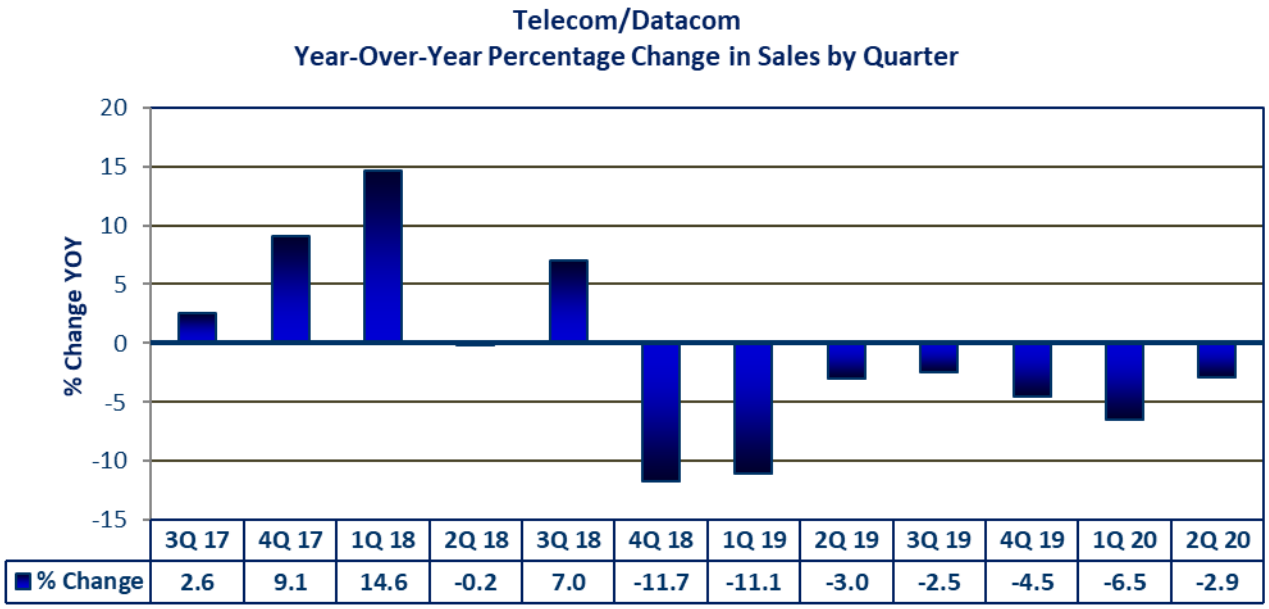
Telecom/Datacom Equipment Sector

The telecom/datacom equipment sector recorded a sales decline of 2.9% in 2019. Sales the first half of 2020 versus the first half of 2019 were down 4.8% year-over-year. Net income as a percent of sales totaled 13.1% for the period, down 7.4% year-over-year.

Telecom/Datacom Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Cisco Systems	1.4%	$26,387.0	$24,133.0	-8.5%
Motorola Solutions Inc	7.4%	$3,517.0	$3,273.0	-6.9%
Nokia	-2.3%	$12,115.9	$11,030.3	-9.0%
Apple (iPhone)	-6.6%	$57,037.0	$55,380.0	-2.9%
Samsung	0.1%	$46,360.3	$43,158.1	-6.9%
Qualcomm	-8.2%	$9,841.0	$10,109.0	2.7%
Ericsson	-1.0%	$11,137.9	$10,888.2	-2.2%
Juniper Networks	-4.4%	$2,104.7	$2,084.0	-1.0%
ZTE Corporation	3.0%	$6,575.1	$6,702.7	1.9%
Total Sales	**-2.9%**	**$175,075.9**	**$166,758.3**	**-4.8%**
Total Net Income		**$21,590.9**	**$19,999.6**	**-7.4%**

$ Millions



Quarter-to-quarter (2Q20 versus 1Q20) sales declined -2.2%. Year-over-year, sales decreased 2.9% in the second quarter.

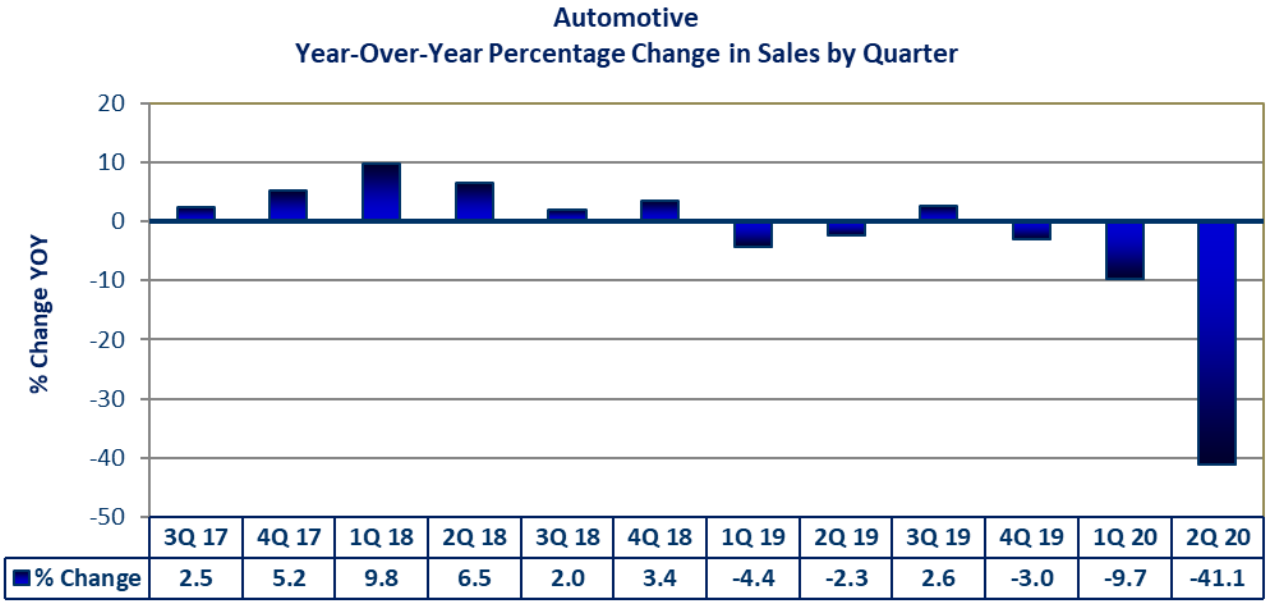
Automotive Equipment Sector

The automotive equipment sector recorded a sales decline of 1.6% in 2019. Sales the first half of 2020 versus the first half of 2019 were down 25.5% year-over-year. Net income as a percent of sales totaled 2.4% for the period, down 149.0% year-over-year. This was the second worst performing industry over this timeframe.

Automotive Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Borg Warner Auto	-3.4%	$5,118.0	$3,705.0	-27.6%
Daimler	3.4%	$55,903.0	$46,459.4	-16.9%
Ford Motor Co.	-2.8%	$79,195.0	$53,691.0	-32.2%
General Motors	-6.7%	$70,938.0	$49,487.0	-30.2%
Lear Corp.	-6.3%	$10,168.1	$6,902.0	-32.1%
Honda	-0.9%	$73,124.0	$51,483.0	-29.6%
Toyota	2.4%	$139,935.1	$107,936.0	-22.9%
Volkswagon	1.1%	$141,435.7	$105,974.8	-25.1%
Kia Motors	0.8%	$23,505.6	$21,553.8	-8.3%
Nissan	-12.0%	$48,787.2	$32,683.2	-33.0%
Fiat	-8.6%	$57,864.9	$35,583.1	-38.5%
BMW AG	1.0%	$54,418.3	$47,648.9	-12.4%
Tesla Auto	14.5%	$10,891.5	$12,021.0	10.4%
Continental AG	-5.4%	$25,209.0	$18,150.9	-28.0%
Total Sales	**-1.6%**	**$796,493.3**	**$593,279.0**	**-25.5%**
Total Net Income		**$29,342.9**	**-$14,371.4**	**-149.0%**

$ Millions



Quarter-to-quarter (2Q20 versus 1Q20) sales declined 33.4%. Year-over-year, sales decreased 41.1% in the second quarter.

Industrial Equipment Sector

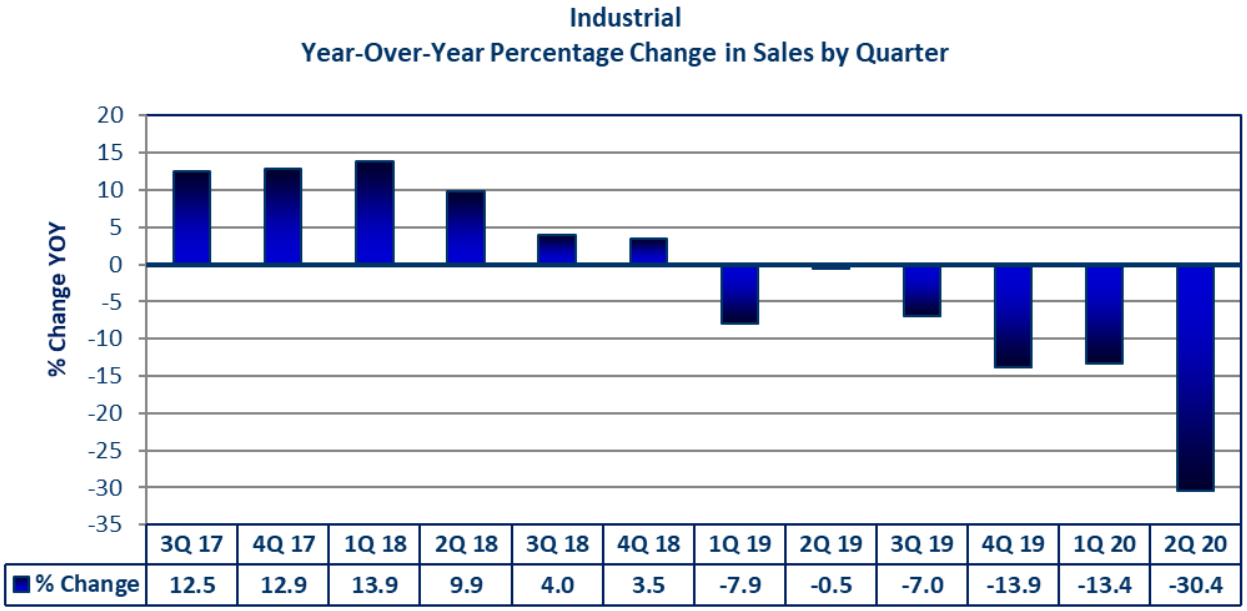
The industrial equipment sector recorded a sales decline of 7.3% in 2019. Sales the first half of 2020 versus the first half of 2019 were down 22.4% year-over-year. Net income as a percent of sales totaled -6.8% for the period, down 182.0% year-over-year.

Industrial Equipment Sector – Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Baker Hughes	4.2%	$11,609.0	$10,161.0	-12.5%
Caterpillar	-1.7%	$27,898.0	$20,616.0	-26.1%
Deere & Co.	1.2%	$21,391.0	$18,198.0	-14.9%
FMC Corp.	-2.5%	$2,398.0	$2,405.0	0.3%
General Electric	-16.9%	$56,517.0	$38,896.0	-31.2%
Parker Hannifin	-2.2%	$7,369.0	$6,863.0	-6.9%
Schlumberger	0.3%	$16,148.0	$12,811.0	-20.7%
ABB	-6.2%	$14,023.7	$12,432.9	-11.3%
Siemens	-9.0%	$40,094.0	$30,551.4	-23.8%
Danaher	1.8%	$2,170.1	$2,060.5	-5.1%
Total Sales	**-7.3%**	**$199,617.8**	**$154,994.7**	**-22.4%**
Total Net Income		**$12,922.3**	**($10,595.5)**	**-182.0%**

$ Millions

Baker Hughes and Schlumberger's $23.3 billion goodwill impairment caused the net income decline for 1Q20. Net income grew 95% without the weight of these adjustments.



Quarter-to-quarter (2Q20 versus 1Q20) sales declined 10.7%. Year-over-year, sales decreased 30.4% in the second quarter.

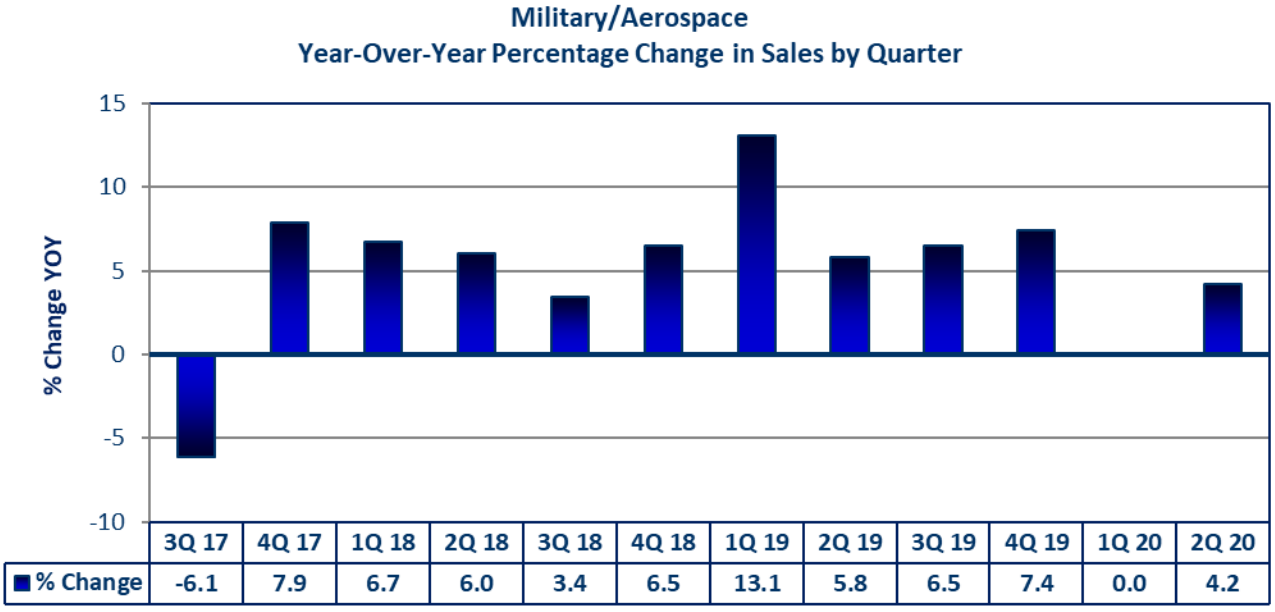
Military/Aerospace Equipment Sector

The military/aerospace equipment sector recorded a sales increase of 8.0% in 2019. Sales the first half of 2020 versus the first half of 2019 were up 2.0% year-over-year. Net income as a percent of sales totaled 4.2% for the period, down 55.7% year-over-year.

Mil/Aero Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Boeing (Mil/Aero)	2.2%	$13,190.0	$12,630.0	-4.2%
Airbus (Mil/Aero)	36.2%	$8,029.9	$7,732.1	-3.7%
General Dynamics	8.7%	$18,816.0	$18,013.0	-4.3%
Honeywell	-12.2%	$18,126.0	$15,941.0	-12.1%
Lockheed Martin	11.3%	$28,763.0	$31,871.0	10.8%
Northrop Grumman	12.4%	$16,645.0	$17,504.0	5.2%
Raytheon Technologies Corp.	-2.4%	$6,336.0	$5,249.0	-17.2%
United Technologies	3.4%	$29,694.0	$32,271.0	8.7%
L-3 Communications	23.7%	$7,268.0	$9,071.0	24.8%
Finmeccanica	32.3%	$6,736.8	$6,423.5	-4.7%
Total Sales	**8.0%**	**$153,604.6**	**$156,705.6**	**2.0%**
Total Net Income		**$14,912.5**	**$6,612.4**	**-55.7%**

$ Millions



Quarter-to-quarter (2Q20 versus 1Q20) sales declined 3.3%. Year-over-year, sales increased 4.2% in the second quarter.

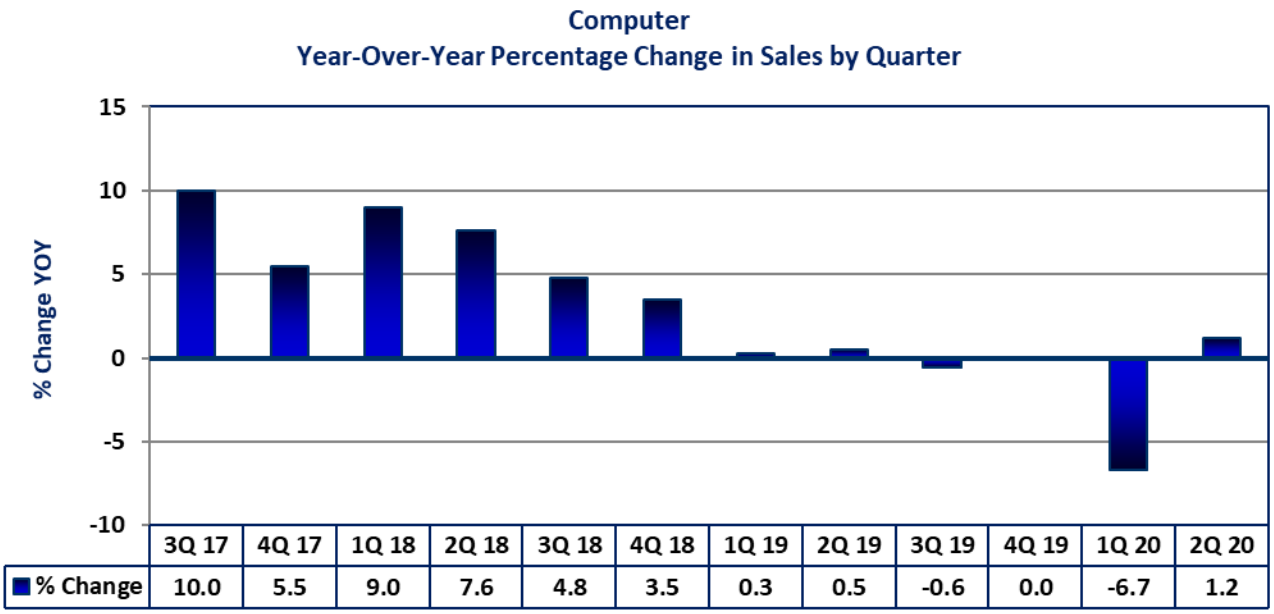
Computer Equipment Sector

The computer equipment sector recorded no sales change in 2019. Sales the first half of 2020 versus the first half of 2019 were down 2.7% year-over-year. Net income as a percent of sales totaled 5.3% for the period, down 34.0% year-over-year.

Computer Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Apple (Computers)	1.8%	$21,730.0	$23,380.0	7.6%
Dell Technologies	1.7%	$45,220.0	$44,534.0	-1.5%
Hewlett-Packard	0.0%	$28,541.0	$26,701.0	-6.4%
Hewlett Packard Enterprise	-6.6%	$14,278.0	$12,754.0	-10.7%
IBM	-3.1%	$37,343.0	$35,694.0	-4.4%
NCR	8.0%	$3,246.0	$2,987.0	-8.0%
ASUS	-3.4%	$5,171.5	$5,437.5	5.1%
Unisys	4.4%	$1,449.6	$954.2	-34.2%
Lenovo	3.8%	$24,221.4	$23,924.0	-1.2%
Advantech	7.6%	$848.3	$843.5	-0.6%
Total Sales	**0.0%**	**$182,048.8**	**$177,209.2**	**-2.7%**
Total Net Income		**$14,222.6**	**$9,390.7**	**-34.0%**

$ Millions



Quarter-to-quarter (2Q20 versus 1Q20) sales increased 14.1%. Year-over-year, sales increased 1.2% in the second quarter.

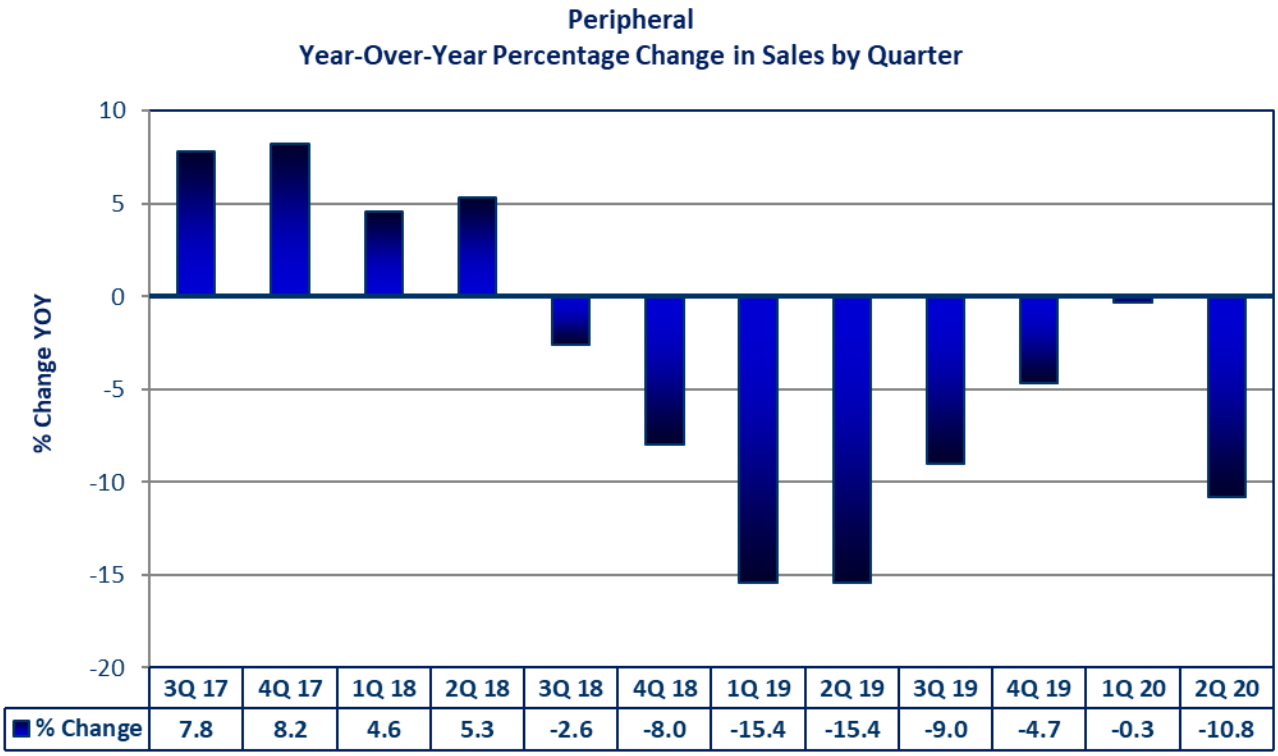
Peripheral Equipment Sector

The peripheral equipment sector recorded a sales decline of 11.2% in 2019. Sales the first half of 2020 versus the first half of 2019 were down 5.6% year-over-year. Net income as a percent of sales totaled 3.4% for the period, down 28.4% year-over-year.

Peripheral Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Western Digital	-19.6%	$7,308.0	$8,462.0	15.8%
Xerox	-7.0%	$4,495.0	$3,326.0	-26.0%
Seagate	-12.2%	$4,684.0	$5,235.0	11.8%
Logitech	3.8%	$1,268.7	$1,501.3	18.3%
Canon	-8.5%	$16,090.9	$13,439.7	-16.5%
Total Sales	**-11.2%**	**$33,846.6**	**$31,964.0**	**-5.6%**
Total Net Income		**$1,508.9**	**$1,081.1**	**-28.4%**

$ Millions



Quarter-to-quarter (2Q20 versus 1Q20) sales declined 7.9%. Year-over-year, sales decreased 10.8% in the second quarter.

Consumer Equipment Sector

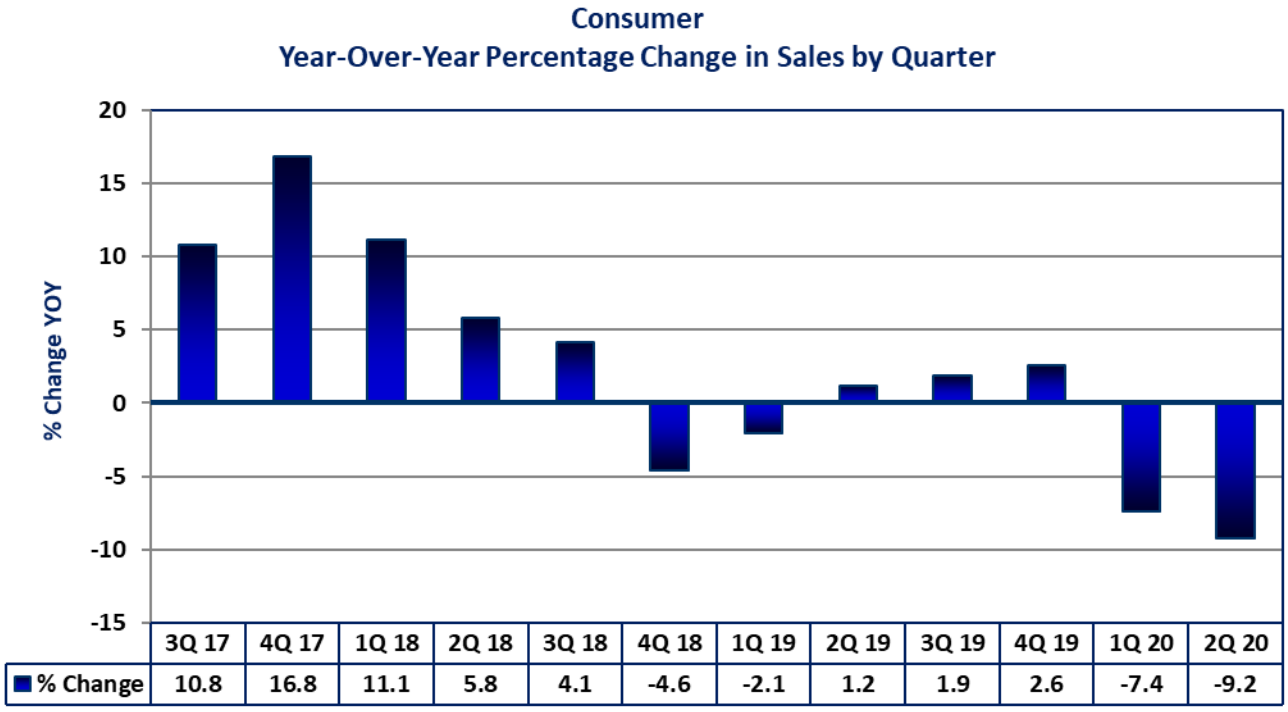
The consumer equipment sector recorded a sales increase of 1.0% in 2019. Sales the first half of 2020 versus the first half of 2019 were down 8.3% year-over-year. Net income as a percent of sales totaled 5.2% for the period, down 6.1% year-over-year.

Consumer Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Eastman Kodak	-3.4%	$598.0	$480.0	-19.7%
Panasonic	-3.4%	$36,045.0	$28,863.9	-19.9%
Whirlpool Corp	-2.9%	$9,948.0	$8,364.0	-15.9%
Sony	2.5%	$36,838.2	$34,354.2	-6.7%
Philips	1.5%	$9,965.3	$9,723.8	-2.4%
Samsung	-1.9%	$34,512.0	$31,275.5	-9.4%
Nintendo	3.5%	$3,411.6	$5,952.7	74.5%
Apple	41.4%	$10,654.0	$12,734.0	19.5%
LG	-4.5%	$26,664.4	$22,890.2	-14.2%
Total Sales	**1.0%**	**$168,636.4**	**$154,638.2**	**-8.3%**
Total Net Income		**$8,550.5**	**$8,031.8**	**-6.1%**

$ Millions

Nintendo's half year sales growth was attributed to continued demand for the Switch game console.



Quarter-to-quarter (2Q20 versus 1Q20) sales declined 2.4%. Year-over-year, sales decreased 9.2% in the second quarter.

Transportation Equipment Sector

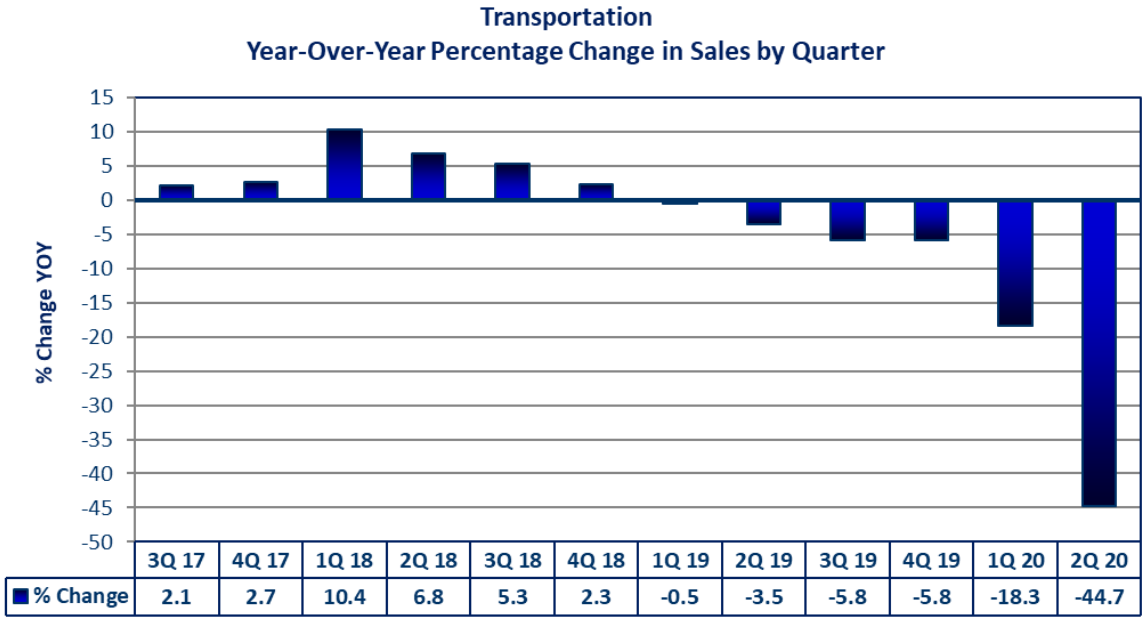
The transportation equipment sector recorded a sales decline of 5.2% in 2019. Sales the first half of 2020 versus the first half of 2019 were down 31.9% year-over-year. Net income as a percent of sales totaled -5.2% for the period, down 177.8% year-over-year. This was the worst performing industry in the first half of 2020.

Transportation Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Boeing (Commercial)	53.8%	$16,544.0	$7,838.0	-52.6%
Airbus (Commercial)	8.4%	$26,663.5	$11,320.5	-57.5%
Bombardier	5.4%	$7,830.7	$6,402.8	-18.2%
Cummins Engine	-0.8%	$12,225.0	$8,863.0	-27.5%
Harley-Davidson	-6.2%	$3,017.4	$2,163.0	-28.3%
PACCAR	9.0%	$13,123.6	$8,213.0	-37.4%
Trinity Industries	-4.3%	$1,340.8	$1,124.4	-16.1%
Wabash Nat'l. Corp.	2.3%	$1,159.2	$726.2	-37.4%
Wabtec	87.9%	$3,829.6	$3,667.0	-4.2%
Agco Corp.	-3.3%	$4,418.8	$3,935.0	-10.9%
Volvo	1.4%	$24,473.3	$17,026.0	-30.4%
Hyundai Heavy Ind.	9.7%	$6,255.1	$6,698.7	7.1%
Daimler (Truck/Bus)	-12.6%	$24,573.7	$16,474.8	-33.0%
Isuzu Motors Ltd.	-3.5%	$9,655.6	$8,199.4	-15.1%
CRRC	17.9%	$14,048.4	$12,594.8	-10.3%
Total Sales	**-5.2%**	**$169,158.7**	**$115,246.5**	**-31.9%**
Total Net Income		**$7,704.0**	**-$5,995.5**	**-177.8%**

$ Millions

Boeing's decline in revenue is due to the 737 Max grounding and delivery delays. Airbus attributed signifcant revenue decline to dimished demand and order cancelations due to COVID-19 crisis.



Quarter-to-quarter (2Q20 versus 1Q20) sales declined 28.0%. Year-over-year, sales decreased 44.7% in the second quarter.

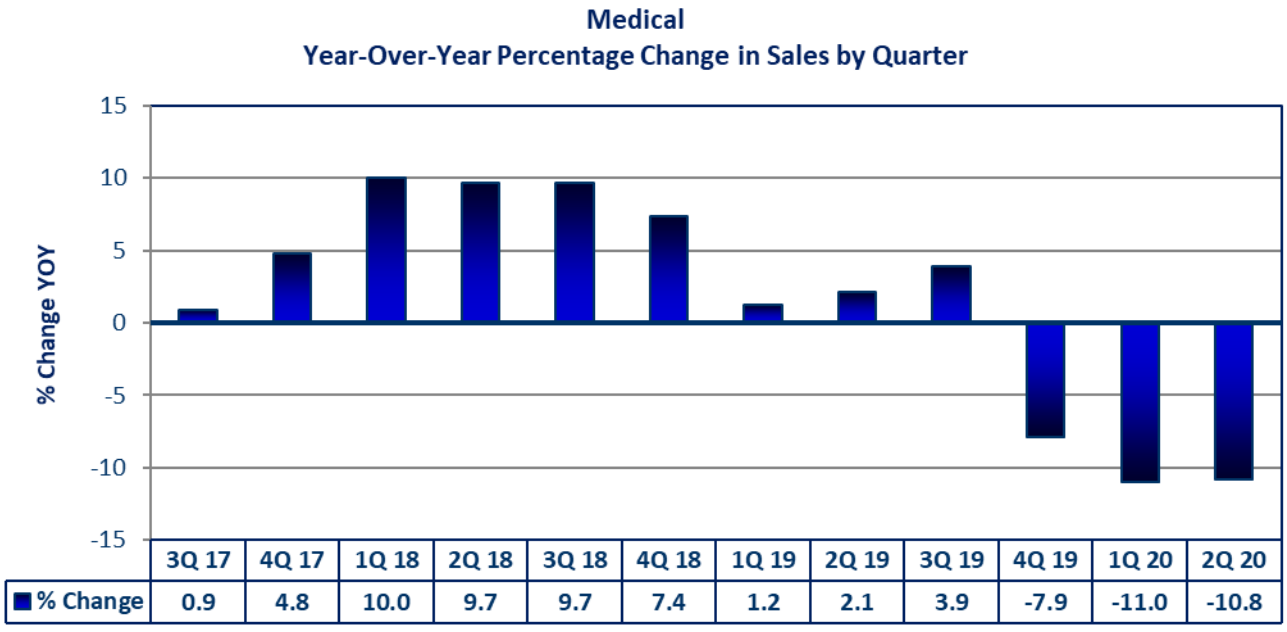
Medical Equipment Sector

The medical equipment sector recorded a sales decline of 0.2% in 2019. Sales the first half of 2020 versus the first half of 2019 were down 10.9% year-over-year. Net income as a percent of sales totaled 7.9% for the period, down 32.7% year-over-year.

Medical Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Becton Dickinson	1.7%	$8,545.0	$8,108.0	-5.1%
Boston Scientific	9.3%	$5,124.0	$4,546.0	-11.3%
Medtronic	1.7%	$15,639.0	$12,505.0	-20.0%
Owens & Minor	-3.1%	$4,945.4	$3,931.0	-20.5%
Quest Diagnostics	2.6%	$3,844.0	$3,649.0	-5.1%
Baxter	2.1%	$5,472.0	$5,520.0	0.9%
Danaher	-13.2%	$7,866.1	$7,580.0	-3.6%
Total Sales	**-0.2%**	**$51,435.5**	**$45,839.0**	**-10.9%**
Total Net Income		**$5,376.6**	**$3,619.9**	**-32.7%**

$ Millions



Quarter-to-quarter (2Q20 versus 1Q20) sales increased 0.9%. Year-over-year, sales decreased 10.8% in the second quarter.

Instrumentation Equipment Sector

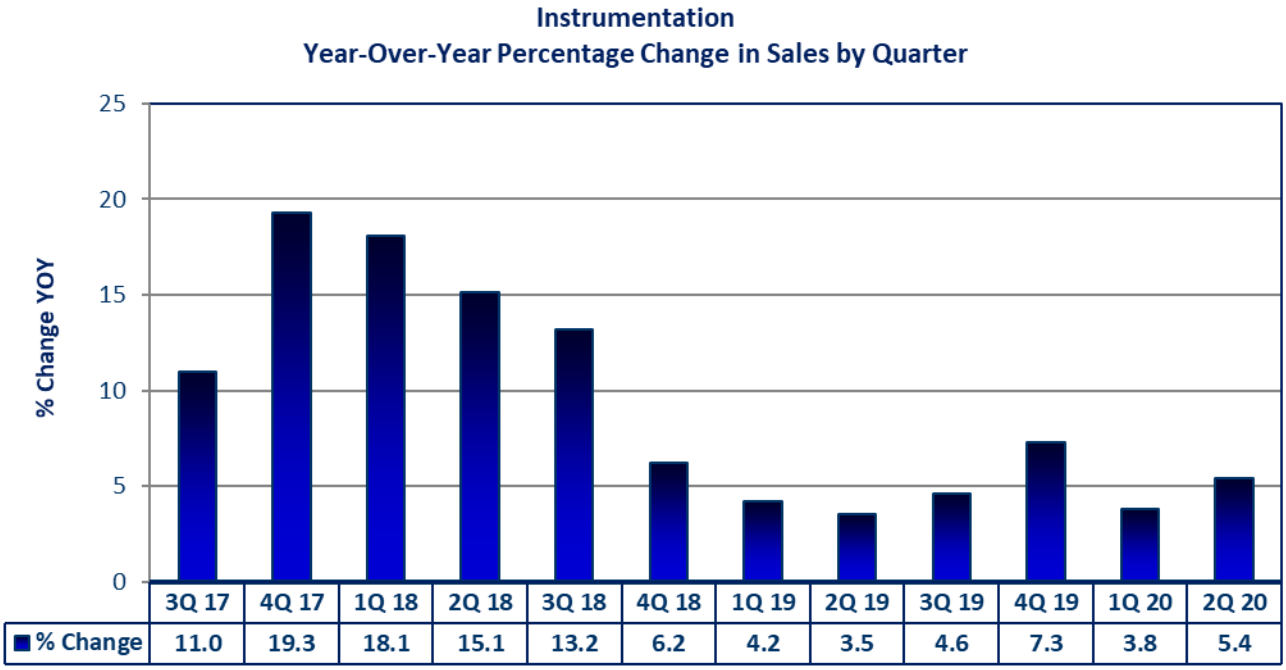
The instrumentation equipment sector recorded a sales increase of 4.9% in 2019. Sales the first half of 2020 versus the first half of 2019 were up 4.6% year-over-year. Net income as a percent of sales totaled 8.3% for the period, down 39.0% year-over-year.

Instrumentation Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
ThermoFisher Scient.	4.9%	$12,441.0	$13,147.0	5.7%
Mettler Toledo	2.5%	$1,410.8	$1,339.8	-5.0%
PerkinElmer	3.8%	$1,371.3	$1,464.1	6.8%
Teradyne	9.2%	$1,058.3	$1,543.0	45.8%
Agilent Technologies	5.0%	$2,512.0	$2,499.0	-0.5%
Fortive	5.4%	$3,457.9	$3,285.0	-5.0%
Total Sales	**4.9%**	**$22,251.3**	**$23,278.0**	**4.6%**
Total Net Income		**$3,176.5**	**$1,937.7**	**-39.0%**

$ Millions

Teradyne revenues increased significantly due to demand for test equipment serving the semiconductor industry.



Quarter-to-quarter (2Q20 versus 1Q20) sales increased 8.1%. Year-over-year, sales increased 5.4% in the second quarter.

Semiconductor Equipment Sector

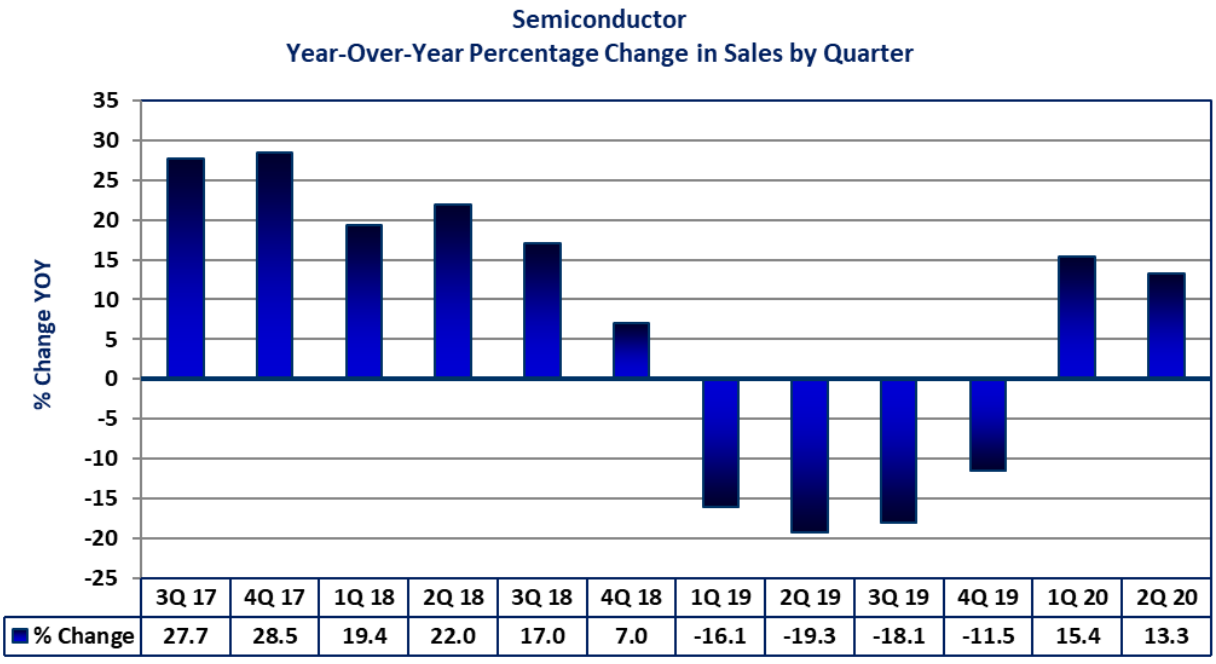
The semiconductor equipment sector recorded a sales decline of 16.3% in 2019. Sales the first half of 2020 versus the first half of 2019 were up 14.3% year-over-year. Net income as a percent of sales totaled 23.2% for the period, down 19.7% year-over-year.

Semiconductor Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
AMD	4.0%	$2,803.0	$3,718.0	32.6%
Analog Devices	-7.6%	$3,006.6	$2,759.6	-8.2%
Intel	1.6%	$32,566.0	$39,556.0	21.5%
Micron Tech.	-34.5%	$10,623.0	$10,235.0	-3.7%
Texas Instruments	-8.9%	$7,262.0	$6,568.0	-9.6%
Xilinx	12.8%	$1,678.0	$1,482.8	-11.6%
Taiwan Semi	1.2%	$14,844.9	$21,890.0	47.5%
Infineon Tech.	-3.3%	$4,517.4	$4,585.3	1.5%
Microchip Tech	5.1%	$2,652.8	$2,636.4	-0.6%
Samsung	-31.8%	$26,664.4	$29,485.2	10.6%
ON Semi	-6.1%	$2,734.6	$2,491.9	-8.9%
Hynix	-37.1%	$11,554.9	$13,185.9	14.1%
Renesas	-4.6%	$3,116.8	$3,190.0	2.3%
Total Sales	**-16.3%**	**$124,024.3**	**$141,784.1**	**14.3%**
Total Net Income		**$27,469.3**	**$32,888.8**	**19.7%**

$ Millions

AMD's revenue increase was driven by higher sales in the computing and graphics segment. Taiwan Semiconductor's revenue grew due to the increase in HPC-related demand and the continued ramp up of 5G smartphones.



Quarter-to-quarter (2Q20 versus 1Q20) sales exhibited no change. Year-over-year, sales increased 13.3% in the second quarter.

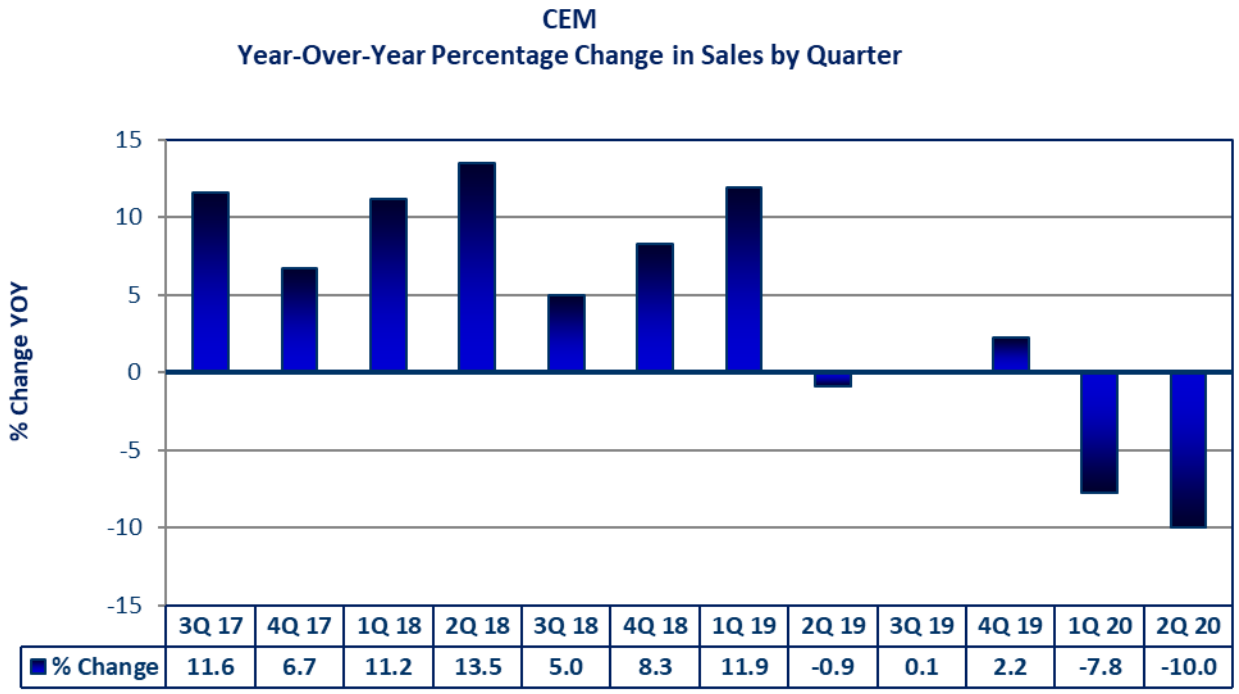
Contract Electronic Manufacturers (CEM) Sector

The CEM sector recorded a sales increase of 3.0% in 2019. Sales the first half of 2020 versus the first half of 2019 were down 8.9% year-over-year. Net income as a percent of sales totaled 0.6% for the period, down 55.9% year-over-year.

CEM Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Benchmark Elec.	-11.6%	$1,204.4	$1,005.9	-16.5%
Celestica	-10.5%	$2,878.8	$2,814.7	-2.2%
Flex	-2.5%	$12,307.1	$10,637.0	-13.6%
Jabil Circuit, Inc.	13.0%	$12,709.1	$12,672.0	-0.3%
Plexus Corp.	9.8%	$1,588.7	$1,624.4	2.2%
Sanmina	4.4%	$4,153.6	$3,246.0	-21.9%
Venture Corp	2.9%	$1,347.8	$967.2	-28.2%
Total Sales	**3.0%**	**$36,189.5**	**$32,967.3**	**-8.9%**
Total Net Income		**$453.0**	**$200.0**	**-55.9%**

$ Millions



Quarter-to-quarter (2Q20 versus 1Q20) sales declined 0.2%. Year-over-year, sales decreased 10.0% in the second quarter.

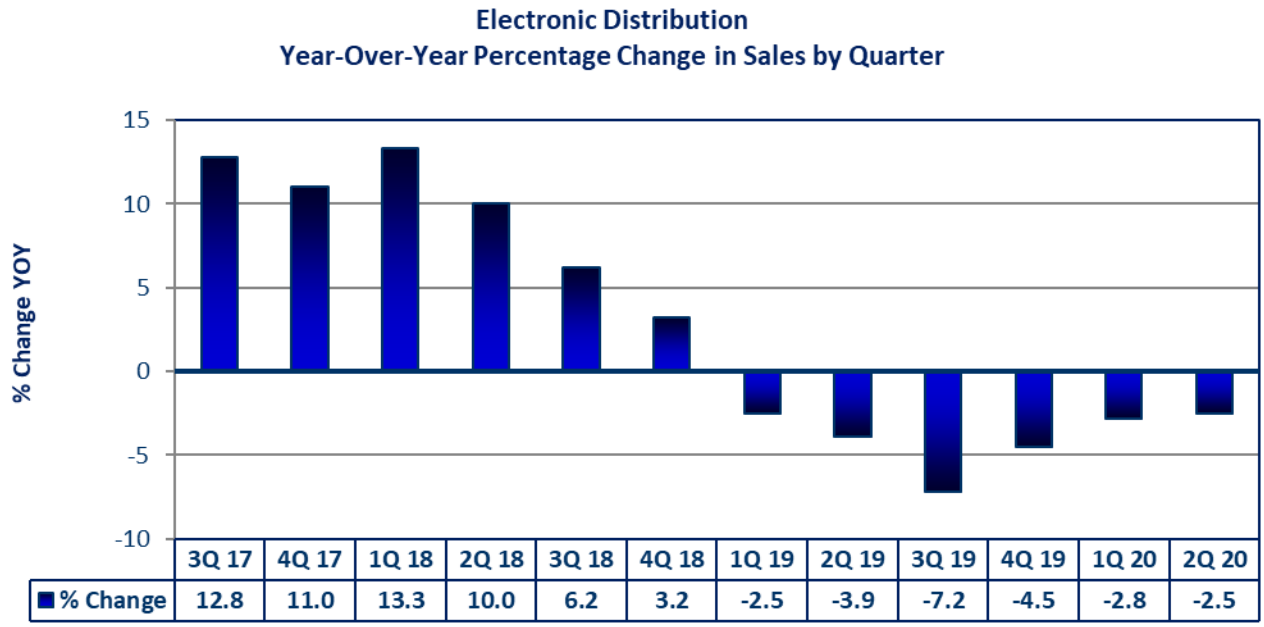
Electronic Distribution Sector

The electronic distribution sector recorded a sales decline of 4.6% in 2019. Sales the first half of 2020 versus the first half of 2019 were down 2.6% year-over-year. Net income as a percent of sales totaled 0.8% for the period, down 197.3% year-over-year.

Electronic Distribution Equipment Sector - Sales and Net Income

Company	2018/2019 % Change	First Half 2019	First Half 2020	Percent Change
Arrow Electronics	-2.6%	$14,501.0	$12,987.0	-10.4%
Avnet	-7.2%	$9,379.8	$8,470.0	-9.7%
WPG Holdings	-5.0%	$7,780.1	$9,365.7	20.4%
Total Sales	**-4.6%**	**$31,660.9**	**$30,822.7**	**-2.6%**
Total Net Income		**-$238.5**	**$232.0**	**-197.3%**

$ Millions

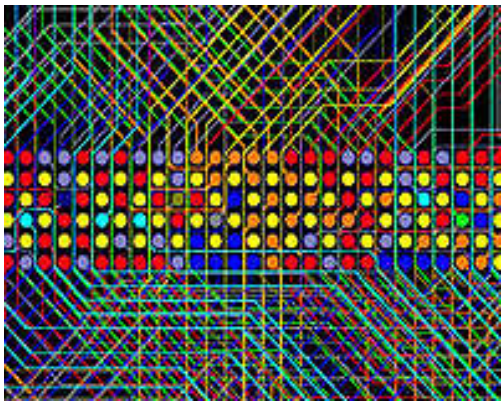


Quarter-to-quarter (2Q20 versus 1Q20) sales increased 4.9%. Year-over-year, sales decreased 2.5% in the second quarter.

Top 12 Trends: Copper to Optical Connectivity

This is the sixth in a series of articles that review leading technology trends that have had a significant impact on the electronic connector industry.

2000	2010	2020
USB 1.0 @1.5 Mb/s	USB 3.0 @ 5 Gb/s	USB 4 @ up to 40 Gb/s
Blackberry	iPhone	Smartphones as a universal interface device
3G cellular	4G cellular	5G cellular
3.125 Gb/s NRZ	25 Gb/s NRZ	112Gb/s PAM4
Rise of data centers	Cloud computing	Edge / Fog computing
Copper circuits	**Increasing fiber options**	**Silicon Photonics / expanded beam technology**
Many proprietary connectors	Licensed second sourced connectors	Rise of open component / system standards
PCIe 1.0 @2.5 GT/s	PCIe 3.0 @ 8GT/s	PCIe 5.0 @32 GT/s
10 Gb Ethernet	40/100 Gb Ethernet	200/400 Gb Ethernet
Multilayer enhanced FR4 backplanes	Multilayer high-performance laminate backplanes	Orthogonal midplane, cable backplanes Twinax cabling
Chip feature size 90 nm	Chip feature size 32 nm	Chip feature size 5-10nm
Antenna TV	Cable TV	Streaming TV



Copper conductors have served the connector industry well since the beginning of the electronics age. The unique qualities of copper, including excellent electrical and thermal conductivity, ductility, and availability, made it the natural choice for conducting circuits that range from milliwatt signal to kilowatt power.

Copper alloys, including beryllium copper and phosphor bronze, provide the required spring characteristics needed to ensure adequate normal force, and they can be formed into complex contact configurations using high-speed stamping dies. A variety of plating materials that range from gold to tin reduce contact resistance, increase durability, and prevent corrosion. Copper cables can be reliably terminated using a variety of techniques, including solder, crimp, insulation displacement, and welding. Copper circuits embedded in multilayer PCB laminate materials have enabled high-density connectivity between hundreds of devices mounted on the board. Components on these boards are attached using high-speed automated equipment and then mass terminated using process-controlled wave soldering equipment. Many years of designing and building reliable copper circuits have resulted in confidence in the media as well as a global supply chain of fully tooled contract manufacturers.

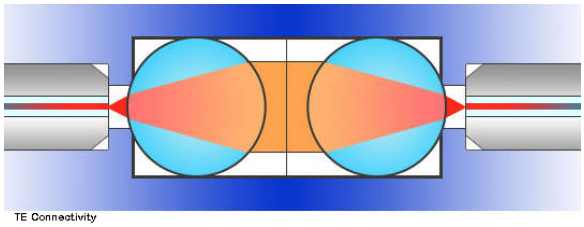
Copper is an excellent material, but it does have its limits. As system speeds continued to increase, copper conductors began to exhibit adverse characteristics. In addition to simple DC resistance, factors such as impedance variations, forward and backward crosstalk, skew, jitter, and inter-symbol interference tend to degrade the quality of a digital signal. Additionally, electromagnetic interference (EMI) and potential for ground loops must be addressed. Each of these negative factors becomes greater as data rates increase, effectively limiting the physical length of a channel. Over the last few years, system designers have begun to push into channels that exceed 25Gb/s, seriously limiting the maximum reach available to a system engineer. Staying within the limits for channel operating margin while taking into account these as well as compensating factors has become an increasing challenge.

Fiber optic links that substitute photons for electrons have been waiting in the wings for years. Modulated light beams that transmit digital information have been the media of choice in very long-distance links where copper channels would require multiple points of amplification and mitigation of distortion. The point at which fiber will become viable for medium to short range channels has been a moving target for forecasters for many years as engineers continued to find ways to extend the life of copper. Improvements in copper channel transmission, including transition to differential pair, and PAM4 signaling, along with advanced signal conditioning built into the SERDES chip, allowed designers to continue to use copper channels in acceptable lengths.

Fiber suffered from several challenges, including the extra cost and power consumed by the electro-optic conversion process required at both ends of an optical channel. A difficult and costly fiber termination process did not help the cause of optical proponents. Fiber was also perceived as more fragile than traditional copper cables.

Attitudes are changing as high-speed channels continue to bump up against the limitations of copper while the costs of fiber cable, connectors, and active components drop. Fiber offers the advantages of much higher bandwidth and reach. Advances in wave division multiplexing and coherent transmission can extend the efficiency of fiber even further.

Extreme sensitivity to any contamination on the mating face of an optical interface has been minimized with the adoption of expanded beam technology, which uses lenses integrated in the connector to increase the diameter of the optical beam across the interface. This technology makes a speck of dust have a much smaller impact on the amount of transmitted light.



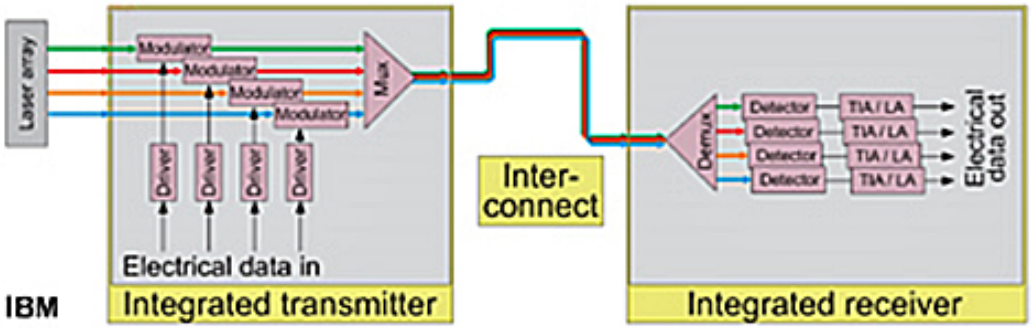
Fiber optics are now being considered for medium to relatively short reach applications in the data center as switch to switch and switch to core, and in some cases even may make sense inside the box.

Efforts to minimize printed circuit material losses and distortion in high-performance applications have spurred interest in lifting those channels out of the board. One solution has been to transition high-speed signals to shielded twinaxial cable attached immediately adjacent to an ASIC or SERDES device. Signal attenuation and distortion is much reduced in these cables, which jump over the surface of the PCB and often terminate to an input/output (I/O) connector mounted on the equipment faceplate.

Another more recent solution is co-packaged optics, which locates the electro-optic conversion process on a common substrate with a SERDES or switch chip, and uses optics to bring the signal directly to the I/O panel. The result is less distortion and higher port density.

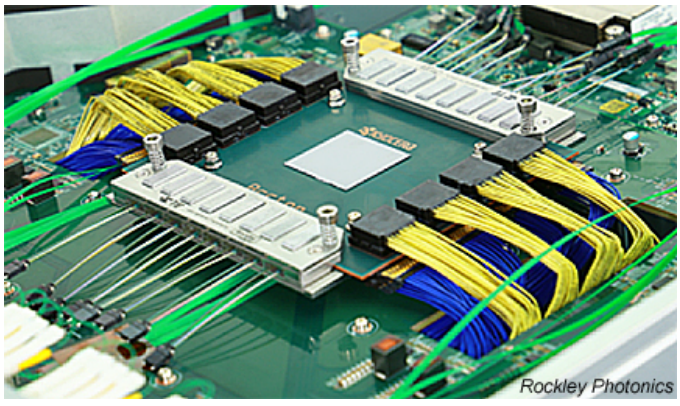
The technology used to achieve this integration is silicon photonics, which seeks to integrate multiple components of an optical transmitter and/ or receiver on a silicon chip. The objective is to replace electrical pulses with photonic signaling. For years, scientists tried unsuccessfully to build a practical laser on silicon. More recently, they have chosen to concentrate on separate laser source and photonic chips mounted on a common substrate. Silicon photonic devices can integrate multiple functions, including, modulators, SERDES, optical amplifiers, detectors, filters, couplers, and splitters with electronic logic, memory, and driver circuits on the same chip.

The advantages this technology offers include:



- Signal density that is measured in micrometers
- Higher speed transmission
- Silicon waveguides can be patterned on a common substrate along with electrical conductors
- Uses existing high-volume IC manufacturing, processes, and wafer test equipment
- Enables the ability to create electronic and optical components on the same microchip
- Enables the ability to do electro-optic conversion on the same chip
- Reduced power consumption
- Increased integration provides increased system density
- Lower system cost through automation

This technology is still more of a concept than a product today, but several suppliers, including Intel, have demonstrated prototypes that illustrate the performance advantages of co-packaged optics. Many engineers see silicon photonics as a long-term solution to the growing challenges of bandwidth bottleneck as well as I/O panel density.



5G Infrastructure

How 5G is Impacting Infrastructure Hardware and Connector Buying Trends

Written for connector manufacturers and channel partners, equipment vendors, and industry analysts, Bishop & Associates' newest research report, **5G Infrastructure – How 5G is Impacting Infrastructure Hardware and Connector Buying Tends** focuses on how broadband service providers are overhauling their infrastructure to provide for the next-gen use cases that are grabbing headlines.

The first waves of broadband infrastructure changes are in-process and already impacting the types of connectors used, who buys them, and how often. The impact is being felt in mobile infrastructure and through the wireline carrier central office and traditional cable television equipment markets. These networks are being converged. As the foundational changes needed for network convergence reach critical levels of implementation next-gen use cases will be ramping up. The first waves of infrastructure streamlining now in process will be a defining trend in broadband equipment connector purchasing through 2025.

The 5G Infrastructure report focuses on how the telecom industry is breaking from its past to prepare for tomorrow. 5G and the first wave of changes underway will introduce a new normal to the infrastructure connector market. Radio area networks will become increasingly sophisticated, and their ongoing evolution will support connector industry growth above 27% through 2025. Connector sales for the rack-based equipment used throughout the rest of the network will grow as well but at a lower rate. The differences here are partly due to the accelerating adoption of more efficient software-defined open-source hardware platforms to replace the proprietary equipment sets that prevail today. The open-source hardware sector of the market will grow at an accelerating pace through 2025.

For service providers to profitably provide a greatly expanded set of services at acceptable prices, they need to first transition to a simpler, more unified infrastructure. As significantly, they need to do it at a pace that makes business sense. Their platforms need to support existing subscribers and ongoing increases in bandwidth as well as be flexible enough to quickly address next-gen use cases. To this end, communication service providers are following the playbook used by the hyper-scale datacenters. The hyper-scalers improved their service flexibility and dramatically reduced costs by converting their voice, video, and data hardware onto unified software-defined hardware platforms based on IP-protocols. What differentiates the telecom industry challenges is that they are implementing these same changes across many hundreds of thousands of locations worldwide.

5G Infrastructure

How 5G is Impacting Infrastructure Hardware and Connector Buying Trends

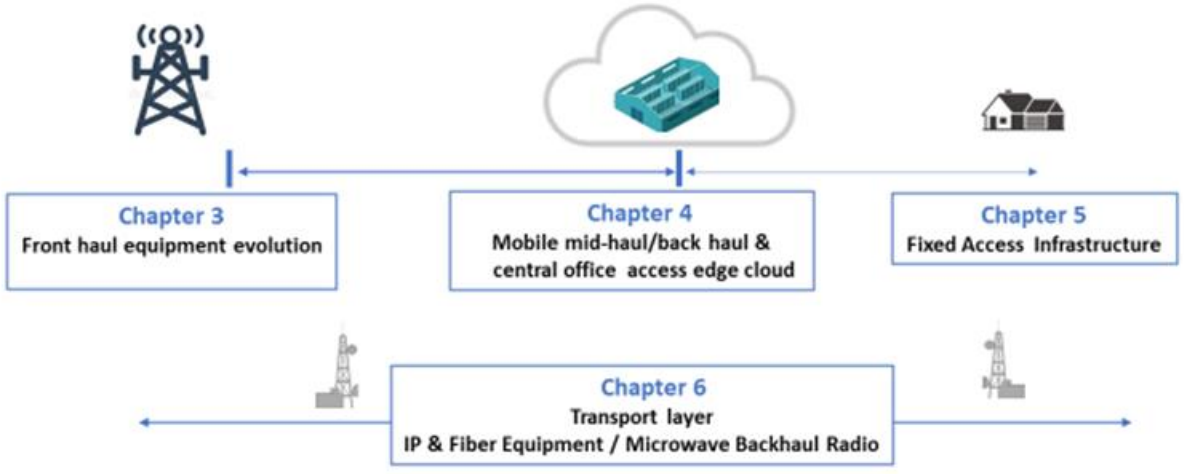
Projections for how the 5G infrastructure market will unfold vary dramatically. If you read the headlines, you might think it is here now. And people may buy their 5G phones tomorrow, but the anticipated service improvements will be incremental and introduced over time. New spectrum will be phased in over years. Radio networks will evolve in phases to provide added 4G-LTE support as well as support the introduction of new 5G services. The underlying networks will be modified to provide for more independent control interfaces.

Our forecasts are based on fundamental equipment trends and how they will impact connector value per equipment class at a strategic level. These are uncertain times. Currency exchange rates, spectrum auction timing, heightened political unrest, new disruptive technologies, and of course, the issues related to COVID-19 all impact predictions.

The report outline provides insight as to how 5G and the hardware changes in-process will impact connector buying trends and a reference timetable for when they will be deployed. Timelines may move in or move out, but the significant changes outlined in this report will largely play out over the next five years.

Chapter Summaries:

There are four chapters of more technical content to the report. Each covers a different segment of the communications service operator infrastructure. The focus in each section is on the primary equipment types, the transitions in progress, and how they will impact connector buying trends.



5G Infrastructure

How 5G is Impacting Infrastructure Hardware and Connector Buying Trends

The following table of contents shows the detail provided in this new report.

Table of Contents

5G Infrastructure

How 5G is Impacting Infrastructure Hardware and Connector Buying Trends

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What's New ?

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