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The Emerging Market for Next-Generation 3DIC Integrated Devices

We are witnessing a trend toward modularization of subsystems for smartphones and other digital devices that will usher in a new class of hardware integrating multichip ICs (logic, memory), active and passive elements (sensors, antenna, power supplies), and advanced packaging technologies such as FOWLPs (fan-out wafer-level packages). These fully functional devices are often referred to as system in packages (SiPs) or multichip modules (MCMs), although we now refer to them as 3DICs.

Application areas in the greatest demand are for mobile communications (smartphones and wearables), factory automation and industrial control, and automotive and telecom solutions. These emerging technologies will help shepherd a new group of advanced IC devices that address artificial intelligence, machine learning, augmented reality, blockchain, and 5G networks.

3DIC integration is starting to take the semiconductor industry by storm. **Apple** is just one of the brands aggressively seeking to embrace such modularization, but new innovations are being made up and down the supply chain by other powerful companies such as **Samsung**, **Foxconn**, **Huawei**, **Compal**, **ZTE**, **Lenovo**, **Flex**, and many others. Back-end semiconductor and SMT equipment vendors like **ASMP**, **Siemens**, **K&S**, and **Assembléon** are starting to merge and streamline product portfolios and supply chains to extend their market reach and capture higher margins (some are now shipping 20–25% of their equipment to clients in the IC assembly industry). End customers include foundries such as **TSMC**, IDMs like **Intel** and **Micron**, and outsourced semiconductor assembly and test (OSAT) suppliers such as **Amkor**, **STATS ChipPAC**, and **Signetics**. PCB manufacturers such as **AT&S**, **LG Innotek**, and **Unimicron** are also getting into the game, while EMS and ODM suppliers like Foxconn, Flex, **Jabil**, Compal, **Pegatron**, and **Wistron** have been investing in these technologies for years. Not to be left out of offering their own solutions are OEM companies like the aforementioned Apple, Lenovo, Samsung, Huawei, and ZTE. Lastly, material suppliers, universities, and research institutes are attempting to establish their own new IC ecosystem solutions.

To understand these inevitable changes, and their ensuing product and market trends, it is highly desirable to do the following: a) Establish technology benchmarks in advanced 3DIC product solutions; b) determine current customer needs and target markets; and c) adequately document the leading suppliers' and players' value proposition and M/A deals in progress. To this end, NVR (publisher of *MMI*) is proposing a multiclient study* to map out the emerging supply chain network and value propositions being established through the interlocking relationships of companies in Asia that are bringing 3DIC solutions to market in the near term.

One example is **Datang Telecom Technology Co.**, one of China's biggest electronics manufacturers, with several key IDM and fabless subsidiaries at its operational core. It is also the historical parent company of **Semiconductor Manufacturing International Corp. (SMIC)**, the country's principal foundry. A significant percentage of its assembly and test work ends up at **Changjiang Electronics**, also known as **CJET**/STATS ChipPAC. **GoHigh** is Datang's wireless modules house and **Uniscope** is its affiliated PCB assembly partner. That's what we call a vertically integrated conglomerate (although we have depicted its process flow in a horizontal manner).

Some articles in this issue

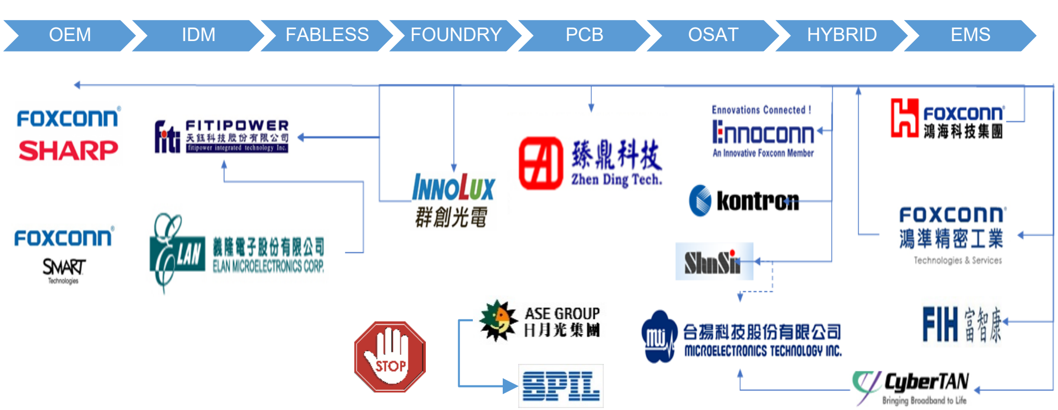
The value chain graphic displayed above points to an important fact, notably that the National Integrated Circuit Industry Investment Fund (ICF), under the administrative guidance of China's Ministry of Industry and Information Technology and Ministry of Finance, owns almost 16% of SMIC and 10% of Changjiang Electronics. Moreover, the fund is endowed with a RMB500 billion budget to encourage mergers, acquisitions, and further equity investments to promote the integration of the Chinese semiconductor industry. By the end of 2017, only CNY118.8 billion had been spent. So, there is a lot more activity to come.

The National IC Fund, in 2015, also obtained a 27% stake in **Tianshui Huatian** (Xi'an), an OSAT, and a 16% stake in **Tongfu Microelectronics**, another OSAT, claiming several seats on each company's board of directors. Yet, besides a major investment in **Changjiang Storage Technology Co., Ltd. (YMTC)**, China's biggest memory project (majority owned by Tsinghua Unigroup), it is SMIC's collaboration with JCET/STATS ChipPAC in the **SJ Semi** venture that is of the highest strategic importance, not only to China, but also to the global electronics value chain.

SJ Semi is a pure-play foundry, specializing in 12-inch micro bumping, wafer probing, and advanced wafer-level packaging. It is a major testing ground for the "TSV MEOL" (mid-end-of-line) concept, designed to develop various assembly/packaging technologies for 3D solutions.

3DIC integration is progressing on three fronts simultaneously: the package level (die, package stacking), the wafer level (die-to-wafer bonding, fan-out WLP), and more recently at the silicon level (TSV). The synergies among these parallel developing areas are critical for future microelectronics packaging.

In the race to achieve higher levels of integration between wafer, package, and substrate, OEMs and IDMs are building their own ecosystems, asserting firm control over integrated design manufacturing, fabless design, foundry, outsourced assembly and test, and PCB assembly operations.



With increasing complexity and integration, the customer requires products in the form of SiPs, PCB assemblies, modules, and subsystems, all in one. Some of the system integrators (e.g., **Skyworks**) claim volume shipments of MCMs exceeding 10 million units per day, which is a significant data point.

We see more and more evidence of vertical integration of IC packaging and PCB assembly (see the Foxconn graphic at bottom), with examples of advanced IC assembly technology moving downstream into the PCB assembly world, but also PCB assembly technology moving upstream into the IC packaging world. Mixed assembly models, such as **ASE/USI**, **China WLCSP/Kaifa**, **IMI/SIIX**, **Kingston/OSE**, **Renesas/IDTI**, **STS Semiconductor/Byd Electronic**, **Tongfu Microelectronics/INESA**, **Xintec/Wistron NeWeb**, **Cirtek**, **Hana Microelectronics**, and **Stars Microelectronics**, have already established footholds, and are successfully delivering vertically integrated products, from components to modules and systems.

In keeping with NVR's COGS analysis approach, our database explores the cost structures, product portfolios, geographic manufacturing assets, customer and supplier base, and capex with R&D plans of OEMs, IDMs, and fabless semiconductor companies that design, manufacture, or outsource the assembly of CPUs, GPUs, APUs, PMUs, SoCs, chipsets, passives, substrates, etc. These and other microelectronic devices are the building blocks of future applications, as demonstrated at the Consumer Electronics Show in early 2018. Artificial intelligence, smart homes (voice assistants), self-driving cars, smart cities, virtual reality and augmented reality, health sensors, robots, 5G, and advanced display technology (micro-LED/OLED) are spurring demand for new electronic products.

** NVR proposes to survey leading suppliers, customers, and industry participants within the electronics assembly market to get a pulse on the 3DIC industry. For a complete proposal of the research scope, deliverables, and cost, please contact Randall Sherman at rsherman@newventureresearch.com.*

Nine-Month Sales Increase for Large CMs

Based on nine-month sales of 20 of the largest contract manufacturers, the outsourced manufacturing space is having a good year. Nine-month revenue for the 20 CMs totaled $298.2 billion, up 13.9% year over year. Sales in US dollars were up at 17 companies, with 13 of them showing double-digit growth (Table 1, p. 4).

The 20 CMs consist of eleven EMS providers, six ODMs, and three hybrid providers. *MMI* recently began using the hybrid category to identify companies that do substantial amounts of both ODM and EMS work and to separate them for the purposes of analysis from those whose sales put them in the traditional EMS or ODM classes. *MMI* believes that this three-way system, though far from perfect, will yield a clearer picture of EMS versus ODM performance while acknowledging the rise of the hybrid model.

Nine-month sales were up collectively for all three groups (11 EMS providers, six ODMs, and three hybrid providers). Combined sales for the EMS group increased 17.5%, thanks largely to **Hon Hai**'s 20.6% increase year over year, versus 7.6% for the ODMs and 10.9% for the three hybrid providers (Chart 1, below right). For now at least, the EMS group is gaining share and poses a competitive threat to both the ODM and hybrid companies.

EMS providers generated the majority of the 20 CMs' sales for the period. Revenue in the EMS category amounted to $177.5 billion, or 59.5% of overall sales. ODMs contributed $67.4 billion, or 23% of sales, while the hybrid group accounted for $53.1 billion, or nearly 18% of sales.

Upon further review, *MMI* has made one change to the EMS group. **Kimball Electronics** has been added to the group, replacing **AmTRAN Technology**. **Wistron** has also been reclassified as a hybrid provider (Table 1).

Of the 17 CMs that grew their nine-month revenue, two are hybrid providers, four are ODMs, and eleven are EMS providers (Table 1). One EMS provider, **Shenzhen Kaifa**, achieved the highest of the double-digit gains, in contrast to EMS provider **Sanmina**, which posted the lowest single-digit gain in the group.

Hon Hai Precision Industry, the EMS giant, had a major effect on the combined nine-month sales of the 20 CMs. Without Hon Hai, combined sales would have been up 9.9% from a year earlier versus 13.9% including Hon Hai.

While nine-month sales were up overall for the 20 CMs, third-quarter results present a brighter picture. Totaling $112 billion, Q3 sales for the entire group rose 18.9% sequentially and 16.5% year over year. US-dollar increases at 16 CMs carried the day, and eight of those gains were of the two-digit variety.

In the year-on-year comparison, 17 companies achieved sales growth in Q3, more than offsetting the declines at the remaining three CMs. **Universal Scientific Industrial**, Hon Hai, Shenzhen Kaifa, **Kinpo Electronics**, and seven others all achieved double-digit increases. On the other hand, sales fell by double-digit percentages at **Venture Corp** and **Ability Enterprise** (Table 1).

There was a wide range in Q3 sales results among the three CM groups. On a year-over-year basis, Q3 sales in the hybrid category increased 1.4%, compared with a 10.4% increase for ODMs and 24.3% growth for the EMS providers. When compared with the prior quarter, the EMS group led with a 20% gain; the hybrid group followed with a 17.6% increase; and the ODM providers had 16.9% growth (Table 2, p. 4).

When combined, Q3 income for the 20 CMs was approximately $1.73 billion, up from about $1.4 billion in the prior quarter and up from about $1.7 billion a year earlier. (Net income was approximate because not all companies follow the same accounting rules.) Net profit increased about 2.1% year over year and the corresponding sales increased 16.5%. At 11 companies, Q3 net income increased versus a year ago, overtaking the losses experienced at 9 others. Both Ability Enterprise and Sanmina reported net income of less than $1 million. Hon Hai represented about 48% of Q3 net income, yet accounted for 41.5% of sales.

For the first nine months, the 20 CMs together earned net income of approximately $4.5 billion. Net income declined in contrast to sales, as net income was down about 2.7% year over year compared with the 13.9% increase in sales for the period. Net margin overall came in at about 1.5% for the first nine months. Aggregate net margin for the EMS providers stood at about 1.7%, above the CM average, while the net margins for the ODM and hybrid groups were below average, at about 1.3% and 1.1%, respectively.

Chart 1: Nine-Month Growth Year on Year (%)

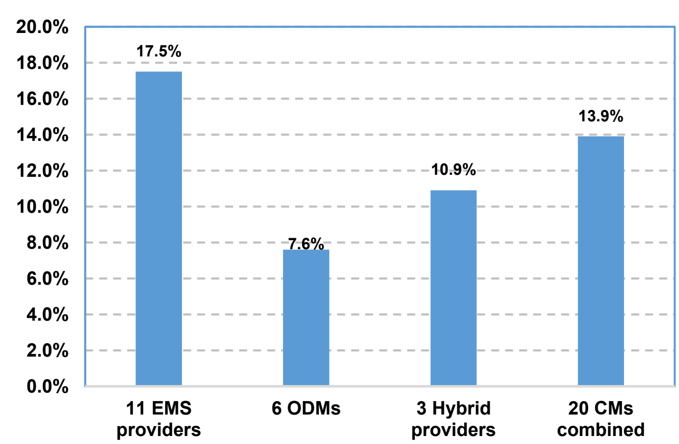


Table 1: Q3 and Nine-Month 2018 Results for 20 of the Largest Contract Manufacturers (US$M or %)

Company	Primary Business	Head-quarters	Reports in US$	3Q2018 Sales	2Q2018 Sales	Qtr.–Qtr. Chg.	3Q2017 Sales	Yr.–Yr. Chg.	3Q2018 Net Inc.	2Q2018 Net Inc.	3Q2017 Net Inc.	Q1–3 '18 Sales	Q1–3 '17 Sales	Yr.–Yr. Chg.	Q1–3 '18 Net Inc.	Q1–3 '17 Net Inc.
Hon Hai	EMS	Taiwan	No	46,502.3	36,485.2	27.5	35,578.8	30.7	840.8	591.1	693.5	118,265.3	98,036.0	20.6	2,257.8	2,209.5
Quanta	ODM	Taiwan	No	9,536.5	7,037.9	35.5	9,107.8	4.7	159.1	119.5	131.7	24,151.6	24,356.4	–0.8	372.4	354.6
Pegatron	ODM/EMS	Taiwan	No	10,883.5	9,168.2	18.7	11,108.9	–2.0	95.7	99.1	120.0	29,685.6	26,887.7	10.4	266.1	360.9
Compal	ODM	Taiwan	No	8,565.0	8,040.3	6.5	7,637.8	12.1	126.2	70.7	76.6	23,331.4	20,842.5	11.9	244.7	120.4
Flex	EMS	Singapore	Yes	6,710.6	6,424.0	4.5	6,270.4	7.0	86.9	116.0	205.1	19,545.4	18,141.3	7.7	183.3	416.7
Wistron	ODM/EMS	Taiwan	No	7,694.3	6,399.8	20.2	6,998.8	9.9	42.0	21.7	30.3	21,538.4	18,921.1	13.8	94.9	75.2
Jabil	EMS	Florida	Yes	5,771.8	5,437.0	6.2	5,023.0	14.9	54.1	42.5	45.7	16,509.9	13,958.2	18.3	164.8	41.1
Inventec	ODM	Taiwan	No	4,768.1	4,289.1	11.2	4,087.9	16.6	53.1	75.6	76.7	12,651.9	11,028.3	14.7	172.3	162.3
Sanmina	EMS	California	Yes	1,876.3	1,813.4	3.5	1,755.0	6.9	(0.2)	34.0	25.8	5,365.3	5,148.6	4.2	58.4	94.0
Celestica	EMS	Canada	Yes	1,711.3	1,695.2	0.9	1,532.8	11.6	8.6	16.1	34.8	4,906.2	4,572.5	7.3	38.8	91.9
Cal-Comp Electronics	EMS	Thailand	No	944.0	846.4	11.5	846.3	11.5	8.2	3.8	6.4	2,576.8	2,323.2	10.9	4.0	24.3
Qisda	ODM	Taiwan	No	1,340.9	1,286.7	4.2	1,159.4	15.7	40.4	27.1	42.2	3,850.4	3,285.1	17.2	101.7	127.6
Universal Scientific Industrial	EMS	China	No	1,470.9	1,035.4	42.1	1,097.2	34.1	60.7	32.3	46.0	3,494.6	2,980.6	17.2	122.7	127.4
Plexus	EMS	Wisconsin	Yes	771.2	726.4	6.2	669.9	15.1	31.6	26.5	29.0	2,196.2	1,893.0	16.0	70.4	83.9
Benchmark Electronics	EMS	Texas	Yes	640.7	660.6	–3.0	610.9	4.9	7.8	10.9	17.6	1,909.4	1,788.4	6.8	35.2	44.2
Shenzhen Kaifa	EMS	China	No	683.8	669.8	2.1	530.0	29.0	42.4	13.6	24.3	1,987.1	1,574.5	26.2	69.6	69.4
Venture Corp	ODM/EMS	Singapore	No	581.8	719.2	–19.1	782.0	–25.6	61.0	73.9	82.0	1,953.8	2,121.1	–7.9	198.8	167.5
Kinpo Electronics	ODM	Taiwan	No	1,224.4	1,092.7	12.0	1,011.6	21.0	6.5	15.3	1.3	3,292.7	2,891.0	13.9	14.5	15.6
Kimball Electronics	EMS	Indiana	Yes	265.6	276.8	–4.0	253.2	4.9	17.5	7.1	8.5	826.3	727.4	13.6	35.3	24.7
Ability Enterprise	ODM	Taiwan	No	61.1	68.8	–11.1	90.4	–32.4	(5.1)	(2.8)	4.3	195.2	283.7	–31.2	(12.1)	7.1
Total/Avg.				**112,004.2**	**94,172.8**	**18.9**	**96,152.1**	**16.5**	**1,737.2**	**1,394.2**	**1,702.0**	**298,233.5**	**261,760.6**	**13.9**	**4,493.6**	**4,618.3**
Total/Avg. without Hon Hai				**65,501.9**	**57,687.6**	**13.5**	**60,573.3**	**8.1**	**896.4**	**803.0**	**1,008.5**	**179,968.2**	**163,724.6**	**9.9**	**2,235.8**	**2,408.8**

Results in non-US currencies were converted to US dollars by applying a three-month average exchange rate for the corresponding quarter. Average exchange rates were based on monthly 2018 and 2017 data from the US Federal Reserve. Company net profits shown here are attributable to shareholders. Net profit totals are approximate because not all companies follow the same accounting standard.

Table 2: Comparing Results Where Companies Are Grouped by Primary Business (US$M or %)

Company (in order of 9-mo. sales)	Primary Business	3Q2018 Sales	2Q2018 Sales	Qtr.–Qtr. Chg.	3Q2017 Sales	Yr.–yr. Chg.	3Q2018 Net Inc.	2Q2018 Net Inc.	3Q2017 Net Inc.	Q1–3 '18 Sales	Q1–3 '17 Sales	Yr.–Yr. Chg.	Q1–3 '18 Net Inc.	Q1–3 '17 Net Inc.
11	EMS	67,348.5	56,070.0	20.1	54,167.6	24.3	1,158.4	894.0	1,136.8	177,582.5	151,143.7	17.5	3,040.3	3,227.1
6	ODM	25,496.1	21,815.5	16.9	23,094.8	10.4	380.2	305.4	332.9	67,473.2	62,687.0	7.6	893.5	787.6
3	EMS/ODM	19,159.6	16,287.3	17.6	18,889.7	1.4	198.6	194.7	232.3	53,177.8	47,929.9	10.9	559.8	603.6
20		**112,004.2**	**94,172.8**	**18.9**	**96,152.1**	**16.5**	**1,737.2**	**1,394.2**	**1,702.0**	**298,233.5**	**261,760.6**	**13.9**	**4,493.6**	**4,618.3**

Net profit totals are approximate because not all companies follow the same accounting standard.

Decent Results for North American Group

For a group of eight mid-tier and smaller EMS providers based in North America, combined Q3 sales were excellent when they are compared on a year-over-year as well as quarterly basis. On a year-over-year basis, the group's revenue was up 10.4%, versus the prior quarter, when revenue was up 1%.

Q3 sales for the group of eight North America-based providers totaled $757 million, representing a healthy growth from the group's year-earlier revenue of $686 million. Among the group, year-over-year sales performance varied greatly, ranging from 56.1% for **SMTC** to 0.3% for **SigmaTron**. There were sales increases among all eight providers Table 3, p. 5). The group's 10.4% growth from a year earlier was slightly above the 10.3% collective gain of the six largest providers in the US-traded sector (Nov., p. 4).

In the sequential comparison, Q3 sales increases at six out of eight providers were offset by decreases at the other two providers. As a result, the group's revenue growth was a mere 1%. Only SMTC and **IEC Electronics** raised their revenue from the previous quarter by double-digit percentages. On a sequential basis, the North American group's 1% growth in Q3 was far behind a 4.3% gain achieved by the six largest US-traded providers (Nov., p. 4).

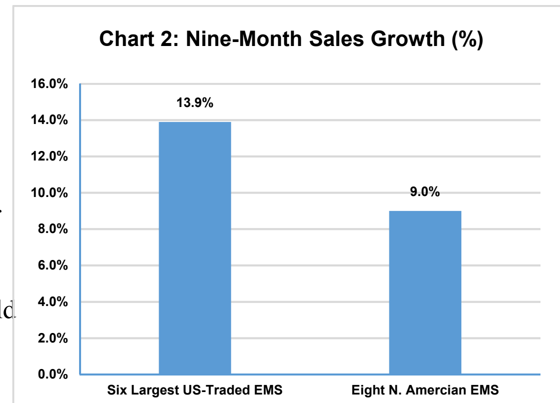
For the first nine months of 2018, sales for the eight mid-tier and smaller EMS providers declined compared with those of their larger counterparts. Nine-month sales for the eight mid-tier and smaller providers increased by 9% year over year, compared with 13.9% growth for their larger competitors (Chart 2). Collectively, the eight mid-tier and smaller providers generated sales of $2.2 billion for the first nine months, similar to $2 billion in the year-ago period. Sales increases at seven providers were enough to boost combined sales. SMTC, IEC Electronics, and **Kimball Electronics** turned in double-digit gains, with 34.5%, 26.9%, and 13.6% increases, respectively.

The group of eight mid-tier and smaller providers consists of seven companies in the EMS space, all publicly traded, and one EMS unit within a larger publicly held corporation. **Sparton Electronics** turned in a high 3Q18 gross margin of 17.9%.

Three providers increased their operating margins sequentially and five raised their margins year over year (Table 3). IEC Electronics achieved the highest operating margin at 6.6%.

The seven stand-alone providers combined for a Q3 net income of $16.7 million, compared with net income of $6.6 million both in Q2 and in the year-ago period. IEC Electronics achieved the highest net income in the group of $9.1 million.

For the first nine months, net income for the stand-alone providers amounted to $48.9 million, an exponential increase from a year earlier, and a far cry from their increase in sales of 9.4%. Kimball Electronics, which posted net income of $35.3 million, was single-handedly responsible for the huge net income increase (Table 3).



A Brief Look at Some Providers

Ducommun, Incorporated (NYSE: DCO). Ducommun's Electronic Systems segment net revenue for the current-year third quarter was $85.6 million, compared to $79.0 million for the third quarter of 2017. The year-over-year increase was due to the following: $6.7 million higher revenue within the company's commercial aerospace end-use markets due to increased build rates on large aircraft platforms; and $2.0 million higher revenue within the company's military and space end-use markets due to increased shipments on military fixed-wing aircraft platforms; partially offset by $2.0 million lower revenue within the company's industrial end-use markets.

Electronic Systems' segment operating income was $9.1 million, or 10.6% of revenue, for the third quarter of 2018 compared with $8.3 million, or 10.5% of revenue, for the comparable quarter in 2017. The year-over-year increase of $0.7 million was due to favorable manufacturing volume, partially offset by unfavorable product mix and restructuring charges.

IEC Electronics Corp. (NYSE: IEC). IEC reported revenues of $34.2 million for the fourth quarter of fiscal 2018, an increase of 24% compared with revenues of $27.6 million for the fiscal 2017 fourth quarter ended September 30, 2017 and a

Table 3: Q3 and Nine-Month 2018 GAAP Results for Eight Mid-Tier and Smaller EMS Providers Based in North America ($M or %)

Company	3Q18 Sales	2Q18 Sales	Qtr.–Qtr. Chg.	3Q17 Sales	Yr.–Yr. Chg.	3Q18 Gross Marg.	2Q18 Gross Marg.	3Q17 Gross Marg.	3Q18 Oper. Marg.	2Q18 Oper. Marg.	3Q17 Oper. Marg.	3Q18 Net Inc.	2Q18 Net Inc.	3Q17 Net Inc.	Q1–3 '18 Sales	Q1–3 '17 Sales	Yr.–Yr. Chg.	Q1–3 '18 Net Inc.	Q1–3 '17 Net Inc.
KeyTronic	127.5	117.0	8.9	109.2	16.7	7.5%	8.0%	7.2%	3.5%	3.4%	2.9%	1.6	–0.1	0.4	352.9	341.4	3.4	2.2	2.7
Sparton	89.5	100.5	–11.0	82.8	8.1	17.9%	24.9%	15.3%	6.0%	11.3%	0.4%	0.2	3.0	–2.9	283.9	282.6	0.5	3.8	–0.7
SMTC	53.7	44.5	20.7	34.4	56.1	9.8%	9.6%	8.6%	2.8%	1.2%	–0.7%	0.9	–0.1	–0.6	135.3	100.6	34.5	0.8	–6.2
SigmaTron	71.4	68.2	4.7	71.2	0.3	8.1%	10.0%	9.5%	1.6%	3.3%	3.1%	–0.5	–3.9	0.4	205.4	199.0	3.2	–4.3	1.6
IEC Electronics	34.2	29.8	14.9	27.6	23.9	13.1%	11.3%	12.6%	6.6%	3.7%	5.9%	9.1	0.2	0.8	95.8	75.5	26.9	10.7	0.9
Nortech Systems	29.6	28.5	3.6	28.3	4.4	11.5%	13.4%	12.4%	4.0%	4.5%	3.3%	0.4	0.4	0.0	84.5	86.8	–2.6	0.4	0.0
Kimball Electronics	265.6	276.8	–4.0	253.2	4.9	6.8%	8.5%	10.2%	5.2%	6.8%	6.3%	5.1	7.1	8.5	826.3	727.4	13.6	35.3	24.7
Subtotal/Avg.	**671.4**	**665.3**	**0.9**	**606.7**	**10.7**							**16.7**	**6.6**	**6.6**	**1,984.1**	**1,813.3**	**9.4**	**48.9**	**23.0**
EMS Unit of Larger Public Company																			
Ducommun*	85.6	84.5	1.3	79.0	8.3							9.1	8.7	8.3	252.5	239.5	5.4	23.5	24.3
Total/Avg.	**757.0**	**749.8**	**1.0**	**685.7**	**10.4**										**2,236.6**	**2,052.8**	**9.0**		

Operating and net income are not necessarily equivalent to GAAP results on a stand-alone basis. Segment operating income did not include corporate general and administrative expenses. (*) For Ducommun, we have considered its Electronic Systems segment figures.

sequential increase of 15% as compared to the third quarter of 2018. Gross profit margin for the fourth quarter of fiscal 2018 improved to 13.1% as compared to 12.6% in the same quarter last year. Selling and administrative expenses increased to $2.9 million but decreased slightly as a percentage of sales to 8.5%, as compared to $2.5 million or 9.0% of sales in the fourth quarter of fiscal 2017. The company reported net income of $9.1 million for the fourth quarter of fiscal 2018, or $0.89 per share, compared to net income of $0.8 million, or $0.07 per share, for the fourth quarter of fiscal 2017. Net income for the fiscal 2018 fourth quarter included a tax benefit of $7.8 million related to the company adjusting its deferred tax asset allowance, reflecting confidence that deferred tax assets will be utilized in future periods. On a non-GAAP basis, excluding the one-time tax benefit, fourth-quarter net income was $1.3 million, or $0.13 per share.

Its fiscal fourth-quarter backlog increased to $133 million, representing 85% year-over-year growth, a level the company has not experienced in more than 20 years. During the fiscal fourth quarter, it also experienced a solid book to bill ratio of 1.3:1. With its visibility, the company expects strong double-digit year-over-year growth in fiscal 2019 and it is eager to start the new year not expecting to experience the seasonal revenue decline from 4Q2018 to 1Q2019 that it has typically experienced in past years.

KeyTronic Corporation (NASDAQ: KTCC). For the first quarter of fiscal year 2019, KeyTronic reported total revenue of $127.5 million, up from $117.0 million in the prior quarter and from $109.2 million in the same period of fiscal year 2018.

For the first quarter of fiscal year 2019, the company had net income of $1.6 million or $0.15 per share, compared to net income of $0.4 million or $0.04 per share for the same period of fiscal year 2018. For the first quarter of fiscal year 2019, gross margin was 7.5% and operating margin was 3.5%, compared to 7.2% and 2.9%, respectively, in the same period of fiscal 2018. During the first quarter of fiscal year 2019, margins were adversely impacted by rising utility costs in Mexico.

For the first quarter of fiscal 2019, its new programs continued to ramp, including a strong contribution from **Skybell Technologies**, despite the continued industry-wide supply chain issues for key components that hampered its growth. Results were adversely impacted by increasing labor costs and the aforementioned rising Mexican utility costs.

The company continued to win new business from EMS competitors, including new programs involving industrial motion control products, power metering, and fire protection systems.

Moving into the second quarter of fiscal year 2019, although it continues to face supply chain issues and increased production costs, it is making significant investments in new equipment and processes to be more productive in both its Mexico and US facilities in anticipation of future growth. Although the details of the tariff situation remain unclear, it seems highly probable that the final outcome will be favorable for its US and Mexican operations. Additionally, customers utilizing its facility in China, who are considering repatriating their business back to North America, are finding its centralized systems and controls to be highly advantageous. For these customers, a move back to its facilities in Mexico or the US can be easily implemented.

For the second quarter of fiscal year 2019, the company expects to report revenue in the range of $120 million to $125 million, and earnings in the range of $0.13 to $0.18 per diluted share. These expected results assume an effective tax rate of 20% in the quarter.

Kimball Electronics, Inc. (NASDAQ: KE). Kimball reported first-quarter 2019 net sales of $266 million, up 5% from the prior-year first quarter. Net income was $5.1 million and diluted earnings per share were $0.19. The company returned $5.4 million to share owners in stock repurchases during the quarter.

Consolidated net sales increased 5% organically compared to the first quarter of fiscal year 2018. The current quarter includes non-operating expense of $0.7 million related to pretax net losses from foreign currency movements, which compares to pretax net gains of $1.1 million recognized in non-operating income in the same quarter of the prior year related to foreign currency movements.

The Romania facility continues to progress in its ramp-up and improved its impact to the consolidated operating income percent by 30 basis points compared to the prior year's first quarter.

Operating activities used cash of $10.0 million during the quarter, which compares to cash used by operating activities of $0.2 million in the first quarter of fiscal year 2018. Cash conversion days (CCD) for the quarter ended September 30, 2018 were 68 days, up from 59 days in the same quarter last year. CCD is calculated as the sum of days sales outstanding plus contract asset days plus production days supply on hand less accounts payable days.

SMTC Corporation (NASDAQ: SMTX). Revenue for the third quarter was $53.7 million, up 56.1% from $34.4 million in the third quarter of 2017. Sequentially, revenue increased 20.7% from $44.5 million during the second quarter of 2018. The year-over-year increase from the third quarter of 2017 was the result of strong demand from both existing and new customers in 2018 and well-diversified demand among the company's target end markets. The adoption of the new revenue recognition standard accounted for $1.7 million or 4.8% of the year-over-year revenue increase.

Gross profit for the third quarter of 2018 was $5.2 million or 9.8% of revenue, compared with $3.0 million or 8.6% of revenue for the third quarter in 2017. Adjusted gross profit for the third quarter of 2018 was $5.1 million or 9.6% as a percentage of revenue, compared to $3.1 million or 9.0% of revenue in the third quarter of 2017. Gross profit for the second quarter of 2018 was $4.3 million or 9.6% of revenue, while adjusted gross profit was $4.4 million or 9.8% of revenue.

Net earnings were $0.9 million for the third quarter of 2018, compared to a net loss of $(0.6) million in the third quarter of 2017. The company reported a net loss of $(0.1) million for the second quarter of 2018.

Adjusted EBITDA was $2.4 million in the third quarter of 2018, compared to $1.1 million for the third quarter of 2017 and $1.6 million in the second quarter of 2018. The increase in the third quarter of 2018 compared to the prior quarter was primarily due to higher revenue in addition to improved gross margin and lower administrative expenses relative to the increased revenue.

Sparton Corporation (NYSE: SPA). Sparton reported first-quarter fiscal-year 2019 net sales of $89.5 million, versus $82.8 million in 1Q18. Gross profit margin was 17.9%; it was 15.3% in the prior year's Q1. SG&A expenses were $12.4 million or 13.8% of sales; adjusted SG&A was $11.7 million, 13.1% of sales. Earnings per share were $0.02 and adjusted earnings per share were $0.20; adjusted earnings per share in 1Q18 were $0.08. Adjusted EBITDA was $6.0 million, a 6.7% adjusted EBITDA margin.

Sparton's MDS segment achieved:

• Gross sales of $59.3 million; $55.3 million in the prior-year Q1

• Gross profit margin of 12.2%; 10.8% in the prior-year Q1

• Operating income of $0.3 million; loss of $1.5 million in the prior-year Q1

• Adjusted EBITDA of $4.5 million, a 7.6% adjusted EBITDA margin

• New program wins in Q1, which have expected revenue of $14.8 million when fully ramped up into production

• Trailing fourth-quarter new program win revenue of $66.3 million, which continues to support future organic growth

• Backlog of $156 million; prior-year Q1 backlog was $131 million

ECP segment achievements were:

• Gross sales of $33.3 million; $30.4 million in the prior-year Q1

• Gross profit margin of 31.3%; 32.7% in the prior-year Q1

• Operating income of $5.1 million; $5.4 million in the prior-year Q1

• Adjusted EBITDA of $6.7 million, a 20.1% adjusted EBITDA margin

• Backlog of $180 million; the prior year's Q1 backlog was $142 million.

On March 5, 2018, Sparton announced the termination by the company and Ultra Electronics Holdings plc ("Ultra") of their July 7, 2017 merger agreement as a result of the staff of the United States Department of Justice (the "DOJ") informing the parties that it intended to recommend that the DOJ block the merger. At that time, the company announced that it would seek to reengage with parties that had previously expressed an interest in acquiring all or part of the company and that are in a position to expeditiously proceed to effect such a transaction.

Modest Growth in Q3 for European Providers

Third-quarter sales for a group of four European EMS providers was modest compared with the year-earlier period. Revenue for the four providers totaled €407.6 million versus €364.1 million in the year-ago quarter. Sales in Q3 increased by 11.9%.

Revenue increases were reported at all four providers, with **Neways Electronics**' growth rate of 16% the highest (Table 4). **Scanfil** and Neways Electronics were the two EMS providers to achieve double-digit growth, with Q3 increases of 14.2% and 16% year over year, respectively.

At Neways Electronics, 3Q2018 sales came in at €126.0 million, an increase of 16.0% compared to 3Q2017. Turnover in the first nine months of 2018 amounted to €373.0 million, up 15.6% compared to the same period of 2017. Strong demand across the board and especially in the semiconductor and automotive sectors contributed. Order intake showed a year-on-year decline of 18.0% in the third quarter compared to the very high level in the same period in 2017. The order book stood at €297.7 million at the end of September 2018, which constituted a 19.8% increase compared to the end of September 2017. The increase in the order book is the result of stronger demand from clients in the automotive, industrial, semiconductor, and medical sectors. The book-to-bill ratio stood at 1.09 at the end of September 2018.

LACROIX Electronics posted revenue of €85.5 million in the third quarter, up 7.5% from 3Q17, confirming the dynamic trend in the first half-year. Increases came in the sales of equipment for road infrastructure management, with higher growth in the third quarter (+16.2%) driven by the road signage business (+18.3%) and with two-digit growth in the traffic management and street lighting businesses. There was also a significant increase in the sales of equipment for water and energy infrastructure management in 3Q18, although revenue for the year is expected to grow at a slower pace than in the first half-year.

Scanfil Group reported turnover for January to March at €139.6 (122.2) million, an increase of 14.2%. The turnover grew in the first quarter from the year before. The Other Industries customer segment turnover was especially good and grew with new customers to €13.8 million (107.6%). Also the Medtech, Life Science & Environmental Measurements customer segment grew €4.9 million (24.4%) from the previous year. In the Networks & Communications segment, however, there was a decline. The largest customer accounted for €11 million (11)% of turnover and the top ten customers accounted for €62 million (58)% of turnover.

Table 4: 3Q2018 Results for Four European EMS Providers (M€ or %)

Company (in order of 3Q18 sales)	Headquarters	Reports in Euros	3Q18 Sales	3Q17 Sales	Yr.–Yr. Chg.
Scanfil	Finland	Yes	139.6	122.2	14.2%
Neways Electronics International	Netherlands	Yes	126.0	108.6	16.0%
LACROIX Electronics	France	Yes	85.5	79.5	7.5%
Kitron	Norway	No	56.5	53.8	5.0%
Total/Avg.			**407.6**	**364.1**	**11.9%**

Results in non-euro currencies were converted to euros by applying a three-month average exchange rate for the corresponding quarter. Average exchange rates were obtained from OANDA. Connect Group was excluded from our analysis, as its latest quarterly results were unavailable.

Company News

API Technologies Enters Agreement with Kitron to Sell Its EMS Business

API Technologies Corp. announced that it has signed a definitive agreement to sell 100% of the capital stock of **API Defense USA, Inc.**, its Electronics Manufacturing Services business ("EMS" or the "Company"), to **Kitron, Inc.**, a subsidiary of Kitron ASA (collectively, "Kitron").

Kitron is an ideally positioned buyer to allow this EMS unit to achieve its growth objectives. For API, this allows it to be singularly focused on strengthening and growing best-in-class technology and market-leading product capabilities within its core RF/microwave, microelectronics, and electromagnetic integrated solutions, power solutions, and secure systems and information assurance businesses.

Jabil Considering 2D Kentucky Site

Jabil is reportedly looking at northern Kentucky as a location for a new facility, and is seeking tax incentives as part of the decision.

The EMS firm is considering adding a second factory in Kentucky that would create some 253 jobs, a total investment of $13.5 million. Of that amount, $9.7 million is allocated for rent, and $3.8 million is for building/improvements.

The average wage including benefits would be $21, according to a target negotiated with the Kentucky Economic Development Finance Authority. At least 90% of the workers hired would be full time and Kentucky residents, per the agreement.

Jabil received preliminary approval for a $2 million tax incentive that would last more than a decade.

Nortech Systems Names Interim President

Nortech Systems announced that Jay D. Miller will become interim president effective January 1, 2019, replacing the retiring Rich Wasielewski.

Wasielewski, who announced his pending retirement in August, will stay on through May 15 as chief executive officer until a successor is hired.

Miller joined Nortech's board of directors in May, bringing broad executive leadership and business experience with a wide range of medical technology companies.

In other developments, John Lindeen will be promoted to senior vice president of global operations, reporting to Miller. Lindeen joined Nortech in 2013, bringing extensive experience in the medical device, defense, and consumer goods industries from companies including Donatelle, Pentair, Remmele Engineering, and Sportech.

Private Equity Firm Lands Sparton

After a near-miss last year, **Sparton** has found a suitor.

The ODM/EMS announced a definitive agreement to be acquired by an affiliate of **Cerberus Capital Management**, the $35 billion private equity firm. Cerberus will pay $18.50 per share in cash for all outstanding shares of Sparton's common stock, putting the purchase price at $181.86 million.

The transaction is subject to Sparton shareholder approval, antitrust clearance, and other customary closing conditions, and is expected to close in the first quarter of 2019.

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