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The latest MEMS commercial report card: Behind the grades.

by [Roger H. Grace](#) |
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The votes have been cast and the results have been announced for the MEMS Industry Commercialization Report Card. (jaker5000/E+/Getty Images)

Introduction

The votes have been cast and the results have been announced for both the 2020 Presidential Elections and the MEMS Industry Commercialization Report Card (Report Card). [Part 1 of this two-part article](#) provided reportage and repartee on the motivation for the creation of this important industry study and its data collection methodology. Also included was a summary of all the letter grades for the 14 subjects over the 1998 to 2019 time period. See Figure 1.



Figure 1: The Report Card final grade for 2019 was B- and has remained at that level since 2015. During the 1998 to 2019 time period, the final grades varied from a high of B to a low of C+. The standard deviation was 0.55. Courtesy: Roger Grace Associates

In this article, we will take a closer look into several of the most interesting topics whose popularity is based on the number of verbatim comments received on each subject from the 43 respondents to this study. Some of the comments that help validate the grades are included below. The final grade of the Report Card for 2019 resulted in a grade of B- which has remained at this level since 2015. I believe that this reflects that MEMS has moved into the mature technology phase of the sensor product life cycle [2], where changes are “evolutionary” versus “revolutionary,” as they tend to be in the earlier phases of the life cycle. See Figure 2.

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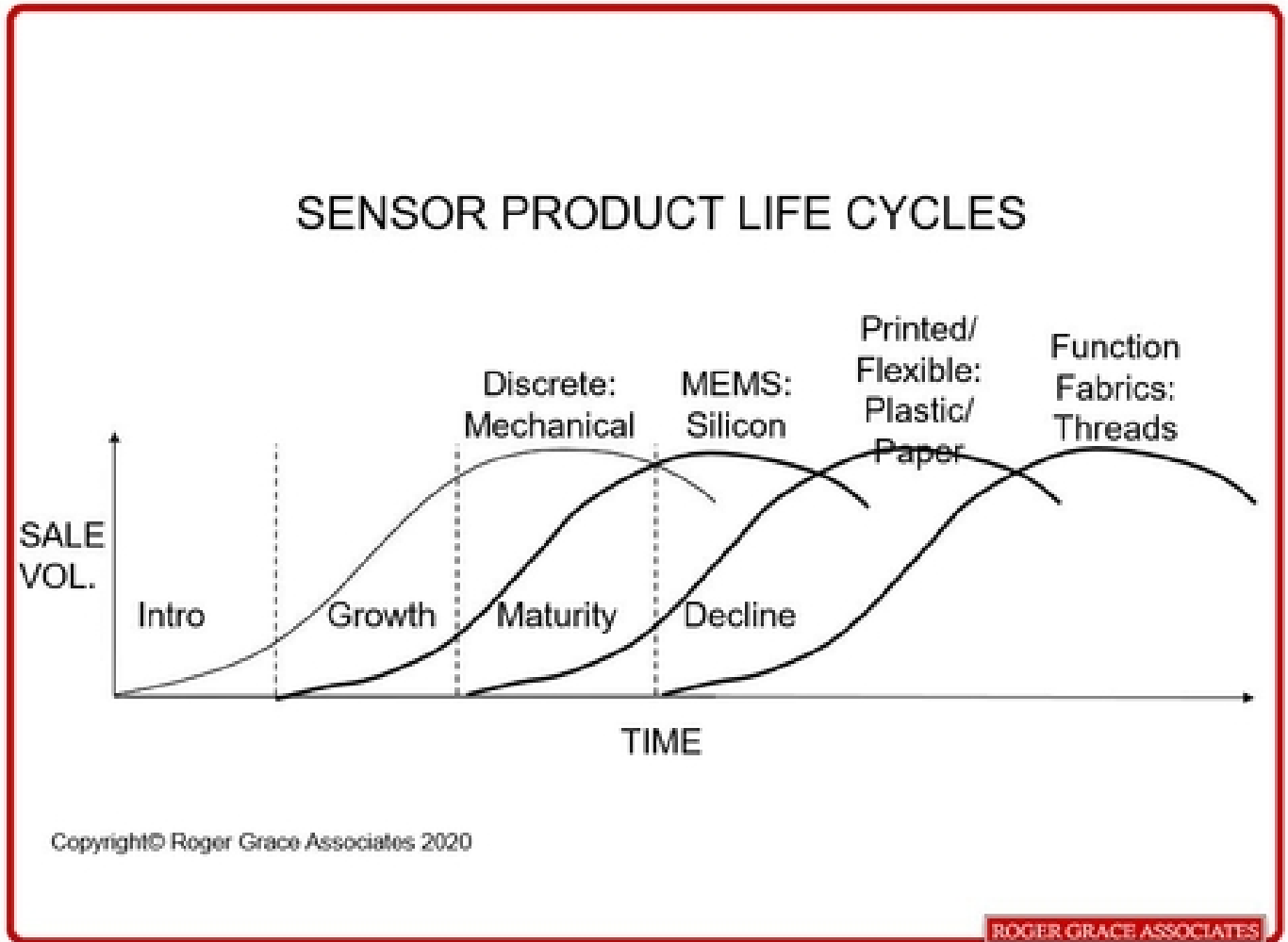


Figure 2: MEMS are in the mature (or third) of the four phases of the sensor product life cycle. MEMS began commercialization in the 1960 and it has been reported that the average time for commercialization of MEMS devices is approximately 30 years. Courtesy: Roger Grace Associates

Marketing

Being a design engineer turned technical marketer over three decades ago, this is one of my favorite subjects. The Report Card has tracked this subject since its origin in 1998, with the overall grades being somewhat lackluster throughout the reporting period. The 2019 grade fell to B- from its B level in 2018. See Figure 3. B has been the highest grade attained since the Report Card's inception in 1998. It had a standard deviation of 1.14 (relatively low). I believe the reason for this is that many organizations in the MEMS industry were created and are managed by engineers who do not necessarily have proper respect and value for the role marketing plays in commercial success. "Marketing Is Everything" [3] is the title of an article that appeared in the *Harvard Business Review* authored by the famous Silicon Valley marketer, Regis McKenna. While I do not fully agree with Mr. McKenna's position, I believe that MEMS

(and sensors) marketing still follows a “technology push” versus “market/applications pull” in many organizations and is greatly misunderstood and/or underutilized. I have attempted to help educate the MEMS (and sensors) industry by publishing several articles on the topic — “MEMS (and Sensors) Marketing: Oxymoron or Opportunity” [4], [5], [6] — in a desire to overcome this serious problem. I consider the following quotes from one of my highly respected and experienced MEMS colleagues to be “spot-on” where he stated:

- “Unless MEMS is widely known and what it can be used for, then I think the marketing has been deficient.”
- “I come across engineers who should be designing products using MEMS but have no idea that MEMS even exist”.

I continue to believe that MEMS (and sensors) marketers need to embrace the concept of educating the audience as to the inherent unique benefits of adopting MEMS devices into their products. It is up to the MEMS marketers to help them accomplish this by providing them with valuable information to ease the process.



Figure 3: The subject of marketing in the Report Card received a grade of B- in 2019 which was a decrease from its B level in 2018. Marketing has consistently received lackluster grades since the Report Card’s inception in 1998 never having received a grade higher than B over the 1998 to 2019 time period. The standard deviation was 1.14. Courtesy: Roger Grace Associates

Venture Capital Attraction / Creation of Wealth / Profitability

I consider these subjects to be the “triumvirate” and the financial elements of the Report Card. Historically, these topics have received the lowest grades of all the 14 Report Card subjects. See Figure 4, Figure 5, and Figure 6. It is interesting to note that the worldwide overall economic situation has had a direct influence on these topics, most notably the optical telecom boom of the 2000 to 2002 period where these subjects received their highest grades in contrast to the world economic crisis of 2008 and 2009 where they received their lowest grades. From a venture capital (VC) perspective, it is a widely held opinion that it has been very difficult for startups who are only creating components to become successful and access adequate and continued funding. What is needed, is that these highly prized sensors must be integrated into a “system” that provides the user with a complete solution. I have called this “MEMS / Sensors-Based System Solutions” [7]. A good case in point is Exo-Imaging Systems that uses their highly proprietary MEMS-based piezoelectric image sensor with sophisticated software,

algorithms and custom designed signal conditioning ASIC to create an ultrasonic imager. It is intended to sell at a fraction of the price of existing imagers, provide higher performance/resolution and be more affordable for distribution in remote villages and towns distant from major medical centers, thus improving patient outcomes and dramatically reducing the cost of patient care. The bottom line: learn to “think outside the chip”.

VC attraction maintained its low grade of C- from 2018. It has consistently received the lowest grades in all of the 14 Report Card subjects since the 2008/2009 economic crisis and an A in the optical telecom boom of 2000/2001. It has the highest standard deviation of 2.66 of all 14 Report Card subjects. The good news is that significant investments are being made to startups by large technology companies e.g. Apple and Intel as part of their strategic technology initiatives. Verbatim comments follow:

- “At best, VCs are highly skeptical of MEMS and are knowledgeable about a number of MEMS failures and the only thing that will turn it around are successful ventures”.
- “VCs tend not to fund MEMS component companies but rather “solution” or systems companies” e.g. Exo Systems (ultrasonic imaging systems) “and about the enabled application.”
- “I think that we have finally arrived at a point where VCs are no longer afraid of MEMS...and they are careful as they should be.”

The last comment is quite encouraging since it comes from a highly respected angel investor/venture capital professional who is expert in the field of MEMS.

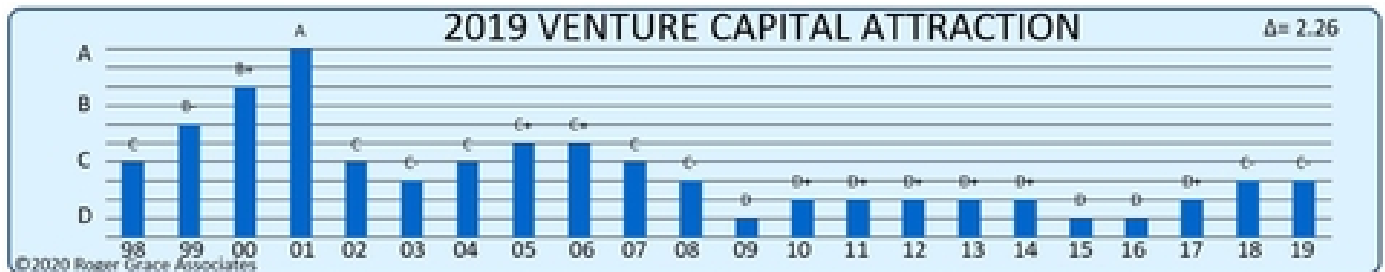


Figure 4: Venture Capital Attraction has been a constantly underperforming subject in the Report Card. The B- grade was maintained from 2018. The standard deviation was 2.66 which is the highest standard deviation of all the 14 Report Card subjects. Courtesy: Roger Grace Associates

Additionally, the ability to MEMS entrepreneurs to become wealthy vis-à-vis their business has been primarily the result of acquisition of these companies by larger ones. Former clients including MEMS pressure sensor provider NovaSensor which was purchased by Lucas (UK) in 1991 for \$25 million, silicon MEMS system timing products provider SiTime acquired by Mega Chips (Japan) in 2014 for \$200 million and the acquisition of Measurement Specialties by TE Connectivity in 2014 for \$1.7 billion followed this strategy. An earlier article entitled “How to Become a MEMS (and Other High-Technology) Millionaire” [8] chronicles this phenomenon. Most MEMS companies

have adopted an exit strategy of acquisition by a larger company, e.g Silicon Microstructures/TE Connectivity, Micralyne/Teledyne and Cavendish Kinetics/Qorvo. It is interesting to note that only a handful of MEMS companies have done an IPO in the over 50-year history of MEMS commercialization, including MEMSIC, SiTime and Invensys. This is compared to dozens of companies that have taken the acquisition route.

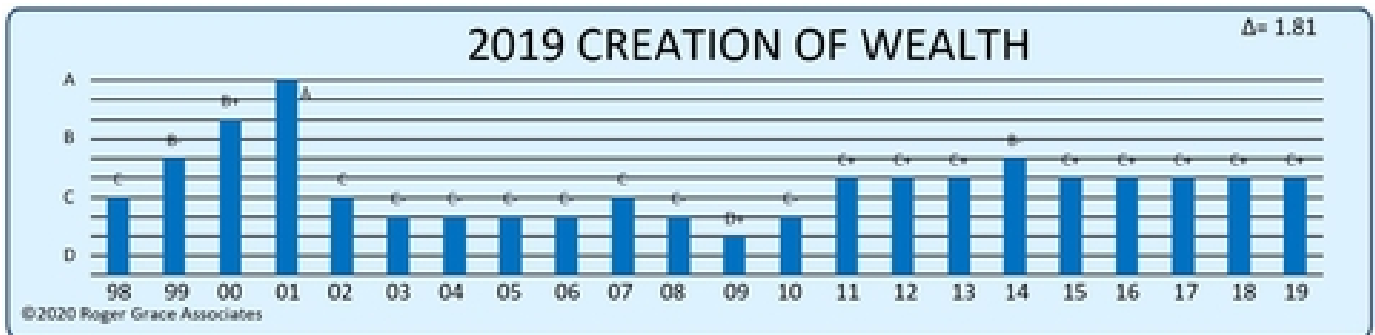


Figure 5: The Creation of Wealth grade for 2019 was C+ which has been maintained at this level since 2015. It reached a level of A in 2001 during the telecom boom of 2000-2002 and fell to the D+ level in 2009 reflecting the worldwide economic crisis. The standard deviation was 1.81. Courtesy: Roger Grace Associates

Profitability continues to be a major problem in the MEMS industry. The 2019 grade for profitability remained at C and has never received a grade greater than C+. The standard deviation was 0.96. This is due in a great part to the rapid commoditization of MEMS devices, especially in the consumer marketplace and even more so in mobile phones, wearables and automotive sectors.



Figure 6: The Profitability grade for 2019 remained at C from the previous year. This is another underperforming subject in the Report Card only achieving its highest grade of C+ in 2014. The standard deviation was 0.96. Courtesy: Roger Grace Associates

Prognostication: The 2020 Report Card

We are closely approaching the end of 2020 — and what a year it has been. I consider it safe to say that the forecast for the 2020 Report Card will include reductions in several of the grades, most especially R and D, marketing and employment. Interestingly, and

in contrast, I feel that several companies with bio/med solutions will buck the trend and do quite well in VC attraction, creation of wealth and profitability.

Marketing is expected to change dramatically, especially in the loss of the ability to have in-person sales meetings and attendance at trade shows/conferences. These situations have catapulted social media and email strategies to the top of marketers' lists of favorite tools, including Zoom meetings, webinars and YouTube videos. Marketing resiliency and the ability to pivot in a recession is paramount, and acceptance of the "new normal" is critical to future survival and success. [9] Bottom line: 2020 will have forever changed marketing as we have known it.

Summary / Conclusions

The 2019 overall grade remained at B- and has been so since 2014, which I believe is demonstrating the maturity of the MEMS industry. The standard deviation from 1998 to 2019 was 0.55. The overall grades of the Report Card have been inextricably linked to the overall technology economy, with high grades during the boom in the 2000-2002 time period associated with the optical telecom bubble and declining grades in the 2008-2009 time period due to the worldwide economic crisis.

The lowest final total grade over the 1998 to 2019 reporting period was C+ which was attained in 1998, 2008, 2009, 2010 and 2012 with the highest at B in 2000, 2001, 2004, 2005 and 2014.

Changes from 2018 to 2019 were:

- Standards increased from C- to C
- Marketing declined from B to B-
- R and D declined from A- to B+
- Design for Manufacturing declined from B+ to B

The R. Grace prognostication for the 2020 Report Card is that several subjects will deliver decreased grades due to the Covid-19. However, on the brighter side, new challenges are expected to bring new opportunities.

Recommended Actions

Some of the key "take-aways" from the 2019 Report Card include:

- Continue to create significant awareness as to the unique solution benefits of MEMS based system solutions (MBSS)...add value
- Understand customer / market needs vis-à-vis rigorous market research...listen to the "voice of the customer"
- Define and establish defensible product differentiation
- Adoption of a marketing / applications pull vs. technology push strategy

- Adopt new media strategies including social media (e.g., LinkedIn), webinars (e.g., Zoom), videos (e.g., YouTube) and email (e.g., Constant Contact) to keep/develop new customers
- Continue to develop manufacturing / packaging solutions that can help differentiate the product from a price / feature / performance perspective...packaging and testing will continue to be "king"
- Accept the fact that obtaining VC funding for MEMS will continue to be a big struggle. Much better routes are via angels, industrial partnering and buy-outs.

Readers best pay attention to the grades that have been documented by the Report Card over its long history to be able to optimally strategize for the future. "Those who forget the past are condemned to relive it"...George Santayana [10].

Want to Learn More?

The 2019 MEMS Industry Commercialization Report Card was presented virtually at the MANCEF Commercialization of Emerging Technologies (COMS) from October 19-22, 2020. A 12- minute YouTube presentation is available on the Roger Grace Associates website...www.rgrace.com.

Want to Participate in the 2020 Report Card Study?

Those wishing to participate in the creation of the 2020 MEMS Commercialization Report Card are encouraged to contact me at rgrace@rgrace.com to receive supporting documentation / ballot and directions.

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