

2023 MEMS commercialization grade weighs in at B-minus again

By Roger Grace

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MEMS Roger Grace embedded devices venture capital



The 2023 aggregate MEMS commercialization grade was B-minus, same as the previous year. One subject decreased by one grade (venture capital attraction); three had a one grade increase (industry roadmap, management expertise and established infrastructure); 10 remained the same. (Michael Quirk/iStock/Getty Images Plus)

It gives me great pleasure to provide the results of the 25th annual silver anniversary issue of the MEMS Industry Commercialization Report Card Study as it has been over the past several years [1],[2]. The 2023 Report Card established an aggregate final grade of B-minus for 14 subjects. Critical success factor grades were submitted by the 52 respondents. More important were the contents of 74 verbatims they provided.

SUBJECT / YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Δ	
R&D	A	A	A	A	A	A-	A-	A-	A-	A-	B+	B	B	B+	B	B	B	B	B-	A-	A-	B-	B	B-	B	B	0	
Marketing	C-	C	C+	C+	C+	C	C	C+	C+	C-	C+	C	C	C+	C+	B-	B-	B	B	B	B	B-	B-	C+	B-	B-	0	
Market Research	C	B-	B-	B-	B	B	B+	B-	B	B	B	B+	A-	B	B-	B-	B-	C-	C-	B-	B-	B-	C+	C	C+	C+	0	
Design For Manufacturing	C+	B-	B	B	B	B	B	C+	B-	B	B+	A-	A-	B+	B-	B	B+	A-	A-	A-	B+	B	B-	B	B	B	1	
Established Infrastructure	C+	B	B+	A	A	A	A	A-	A-	A-	B+	B+	A-	A-	A-	A-	A-	A-	A-	A-	A-	A-	B+	B-	B	B+	1	
Management Expertise	C	C	C+	C+	C+	C+	C+	B-	B-	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	1	
Venture Capital Attraction	C	B-	B+	A	C	C-	C-	C+	C+	C	C-	D	D+	D+	D+	D+	D+	D	D	D+	C-	C-	C	C-	B-	C+	-1	
Creation Of Wealth	C	B-	B+	A	C	C-	C-	C-	C-	C	C	D+	C	C+	C+	C-	B-	C-	C-	C+	C+	C+	C+	C	C+	C+	0	
Profitability	C-	C-	C-	C-	C-	C-	C-	C	C+	C	C-	D+	D	C-	C	C+	C+	C	C-	C-	C-	C	C	C+	C	C	0	
Industry Roadmap		B-	B	B+	A-	A	A	B	B-	C+	C-	C-	C	C	C	C+	B-	C+	C	C-	C	C	C	C	C	C	C+	1
Industry Association				B	B+	B+	B+	B	B	B+	B	B	A-	B+	B+	B+	B+	B+	A-	B+	B-	B-	B-	C+	B	B	0	
Standards					C	B-	B-	B-	C+	C	C	C	C+	C	C	C+	B-	C+	C-	C-	C-	C	C	C-	C	C	0	
Employment						C	C	C+	C+	C+	C	C	C	C+	C+	C+	B-	B-	B	B	B	B	B	B	B	B	0	
Cluster Development						B	B+	B+	B	B-	C+	C+	C+	C	C+	C+	B-	C+	B-	C+	C+	C+	C+	C	C+	C+	0	
Overall Grade	C	B-	B	B	B	B	B	B	B	B	C	C	B	B	B	B	B	B	B	B	B	B	B	B	B	B	0	

Figure 1: The MEMS Industry Commercialization Report Card was created in 1998 and has been conducted annually. In its 25th silver anniversary year, the 2023 aggregated grade was B-minus which it maintained from the previous year. One subject had a one grade decrease, three had a one grade increase and 10 remained the same. (Roger Grace Associates)

At the famous 1998 Hilton Head Conference (which successfully celebrated its 40th anniversary this June), I was recruited to be a panelist and address the topic, "Why are there not more MEMS millionaires?" After providing my opinions along with several others on the topic, I concluded that there must be a basis for this problem. Subsequently, an extensive research project was initiated into the field of technology commercialization...including theory and several case studies which initially established nine "critical success factors" important to achieve successful commercialization. Five additional factors were added by the year 2003 bringing the total to 14 where it continues to this day.

Why a report card?

While there are currently over a dozen research reports available on the size of the MEMS market, the Report Card is unique in that it provides a detailed, objective and candid assessment of the current status of the commercialization success of the MEMS industry vis-à-vis inputs of thought leaders. Thus literally providing a “vox populi” (Latin: voice of the people) assessment.

Benefits

Using the results of the Report Card from both grade and verbatim perspectives provides MEMS industry practitioners with an objective assessment of the health of the MEMS industry...both currently and historically. Also provided are actionable strategies to gain competitive advantage in overcoming the barriers to the successful commercialization of MEMS. As the famous Spanish philosopher George Santayana stated...“ those who forget the past and condemned to relive it.” [3]

Research methodology

Unlike the many currently popular polls (projections) that are used to assess the political landscape where the results of selected samples of hundreds to thousands of people in the research universe provide results translated to a plus/minus degree of accuracy, the strategy that has been embraced here and since its first use in 1998 is a modified Delphi/Mass Observation approach. Here, a limited number of experts are asked their opinions on a specific subject. Approximately 100 individuals were solicited with 52 completed questionnaires received. This greater than 50% response rate is truly exceptional in the market research community where response rates are typically in the low single digits. Noteworthy also is the average number of years of the respondents' MEMS industry experience-- 25 years-- which equates to over 1,000 years of combined experience.

Results

As previously mentioned, the final aggregated grade was B- as it was in the previous year. The individual grades summary follows:

Three subjects had a one grade improvement...Established Infrastructure, Management Expertise and Industry Roadmap

One subject had a one grade decrease: V.C. Attraction

Ten subjects experienced no change in grade

In the review of the past 25 years' performance, the grades were highly positively correlated with the social economic conditions for the specific reporting period. Noteworthy was the downward change of the aggregated final grades of 2008/2009 to C+ from B- because of the worldwide financial crisis and the downward change of the aggregated final grade from B- to C+ for the year 2021 with Covid's impact considered to be the major factor for the decline. Figure 2.

Verbatims

A total of 74 verbatims were received. The subjects which received the most verbatims were: R&D (13) and VC Attraction (12). The least popular subjects were: Creation of Wealth (2) and Management Expertise (0). Additionally, a key word search was conducted on the following topics: Covid (5), Chips Act (5) and A.I. (1). The Final Report of the Report Card provides all 74 verbatims categorized by subject.

Is MEMS a mature technology?

I argued in my June 26 presentation on the Report Card at Sensors Converge 2024 [4] that MEMS/silicon is the second wave of the sensor's product life cycle with the previous wave being that of mechanical sensors (e.g. LVDT) and with the successive waves being printed/flexible/stretchable sensors followed by functional/smart fabric sensors. It is interesting to note that a vis-à-vis assessment of more than 10 different market studies, the average compounded annual growth rate (CAGR) for MEMS from 2021-2031 was approximately 8% with a total worldwide market value of \$14 billion (US) in 2022.

This is a major departure from the MEMS growth rates experienced in the 1980's and 1990's that were solidly in the double-digit range. I conclude from this that MEMS are approaching the apogee of the mature phase of their product life cycle, having successfully passed through introduction and growth phases with innovation successes in its maturity phase moving to primarily incremental versus being disruptive, as occurred in the early years of the 1960's and 1970's.

Summary

The results of the 2023 Report Card returned a total aggregated grade of B- as in the previous reporting period and up from C+ in 2021. There were relatively low changes in the individual grades (four) versus previous years of 10 total grade changes in 2022 and 13 total grade changes in 2021 (an all-time high) ...thus inferring existing stability/maturity at this time.

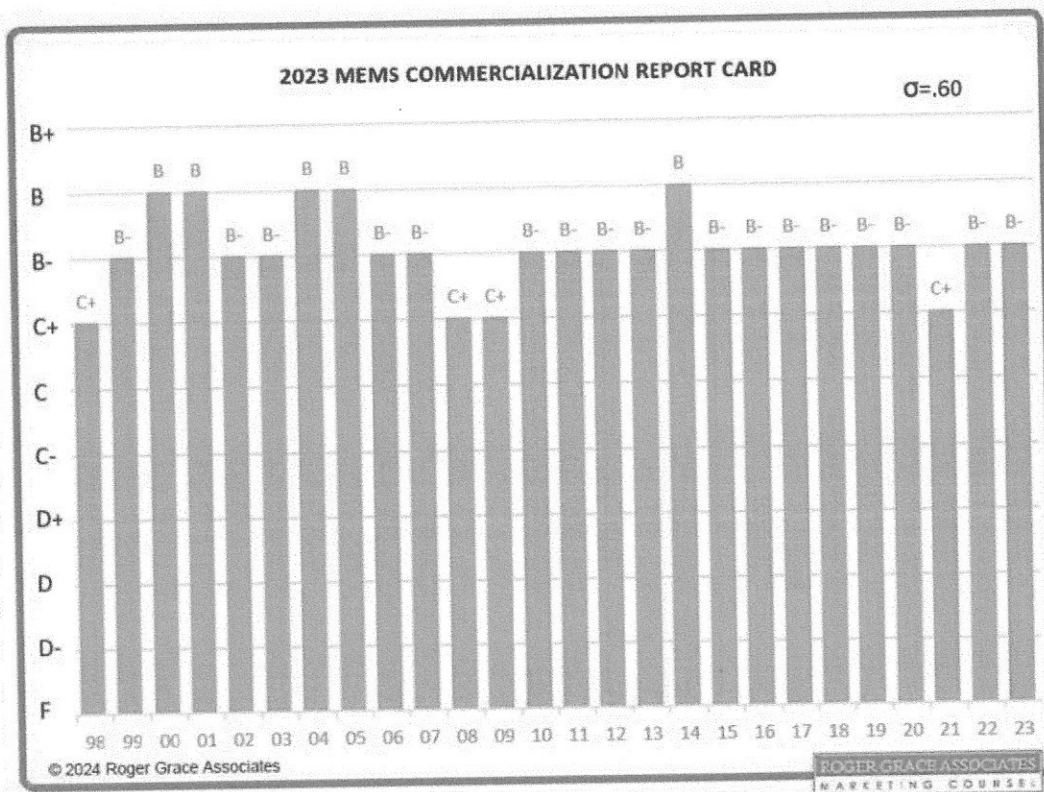


Figure 2: The 2023 Report Card demonstrated the level of stability, resilience and maturity of the MEMS industry by continuing its grade of B- from 2022 results and its successful bounce-back from its C+ grade of 2021 driven by the effects of Covid. The yearly overall grade has not changed more than one level from the previous year and has varied between C+ and B over the 25 years of the conducting of the study. Standard deviation was 0.60 from 1998 to 2023. (Roger Grace Associates)

It is interesting to note that the 2023 Report Card results have significantly demonstrated the resilience of the MEMS industry vis-à-vis its individual grades to bounce back in a relatively short time from the major impact of Covid as seen by the dismal individual grades of the 2021 Report Card versus that of the following two years. We encourage MEMS industry practitioners to embrace the results of the Report Card and provide judicious guidance and a pragmatic lessons learned.

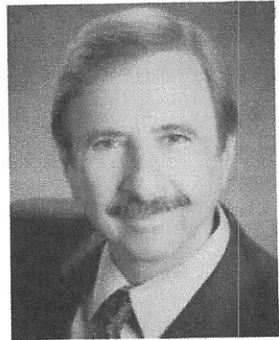
A copy of the Report Card Final Report providing all 74 verbatims and details on the existing opportunities for successful MEMS commercialization, challenges it faces and the recommended strategies to overcome them can be found on the Roger Grace Associates website...www.rgrace.com (<http://www.rgrace.com>).

References

- [1] R. Grace; Covid and Supply Chain Woes Help Drive Dramatic Drop in MEMS Report Card; (<https://www.fierceelectronics.com/sensors/covid-and-supply-chain-woes-help-drive-dramatic-drop-mems-report-card>) Fierce Electronics; August 1, 2022.
- [2] R. Grace; Study Sees Positive Turnaround in MEMS Commercialization; Fierce Electronics; August 1, 2023; www.rgrace.com (<http://www.rgrace.com>).
- [3] G. Santayana, The Life of Reason, 1905
- [4] R. Grace; The 2023 MEMS Industry Commercialization Report Card; Sensors Converge; June 26, 2024; www.rgrace.com (<http://www.rgrace.com>).

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He was a founding member of MANCEF and currently is its vice president of the Americas. Specializing in micro electro mechanical systems (MEMS) and sensors for over 40 years, he is considered a pioneer in this field. He has authored over 40 technical feature articles, organized, chaired, and spoken at over 50 international technical sessions and is frequently quoted as an industry expert in major international technical and business publications. He is a recipient of the Outstanding Engineering Alumni of the Year in 2004 by Northeastern University and was bestowed the inaugural Sensor Industry Impact Award by Sensors Magazine in 2016. Mr. Grace held the position of visiting lecturer at the University of California at Berkeley from 1990 to 2003. His educational background includes a BSEE and MSEE (as a Raytheon Company fellow) from Northeastern University, and the MBA program at Haas Graduate School of Business at UC Berkeley.



MEMS

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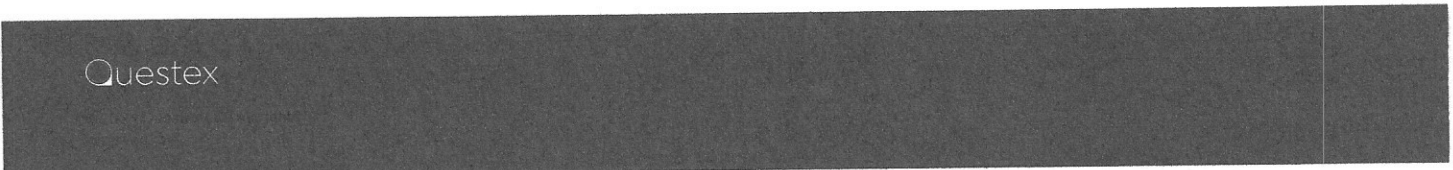
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