

Expert Contributors

Barriers to The Successful Commercialization of MEMS

The 2018 MEMS Industry Commercialization Report Card

By Roger H. Grace, President of Roger Grace Associates

Introduction

This article provides the results of the 2018 MEMS Industry Commercialization Report Card Study (Report Card). This article will be the first episode in the series to address the subject. While this episode will address the background and methodology of the study and provide the summary results, future articles will delve more deeply into the specific topics and

provide “verbatim” from the many of the respondents to the study in addition to my interpretation of the inputs.

The Report Card first appeared for the year 1998 and as such, the 2018 marks the twentieth anniversary of this annual study. For the establishment of the specific topics of the Report Card, market research was conducted on the general topic of technology commercialization and resulted in the selection of a number of critical success factors (a.k.a. topics) that were considered necessary for successful commercialization specific to MEMS and to the MEMS industry. The Report Card began with nine topics in 1998 and by 2003 it had expanded to 14 based on continuous reassessment of the ever-changing dynamics and resultant performance of the MEMS industry. It has remained at this level since 2003.

The purpose of the Report Card is to provide MEMS industry participants with an objective assessment of these critical success factors over time and to act as a tool to help them better understand, respond to and exploit the ever-changing dynamics and evolution of the MEMS industry. The Card has been developed not only to help assess the progress of the commercialization of this technology over time but more importantly to serve as a vehicle to help guide industry participants to best overcome the barriers to the successful commercialization of MEMS and to achieve maximum commercialization success.

The Report Card is unique in the technology commercialization strategy sector and also to the MEMS industry. It has been widely published and presented worldwide since its introduction in 1998 and is widely accepted internationally as a valuable tool for MEMS industry participants desirous of creating winning business strategies for their organizations.

The Problem

It is interesting to note that MEMS technology, established vis-à-vis the discovery of the piezoresistive effect at Bell Laboratories in 1955 by Charles Smith, is approximately the same age as Integrated Circuit (IC) technology established vis-à-vis the semiconductor effect that was discovered at the same laboratory by Bardeen et al. only a few years earlier. More importantly however, the total sales of MEMS as reported by numerous groups in 1998 was approximately 1/25th of the sales of ICs at the time of the publishing of the first Report Card.

The MEMS market for 2018 has been reported by several organizations to be approximately \$ 13-15 Billion (US) whereas the total IC market for 2018 was reported to be in excess of \$536 Billion (US), approximately a 30:1 ratio. The positive news here is that the MEMS market has been reported to be growing over the past several years at a compounded annual growth rate (CAGR) in the low teens range (primarily fueled by mobile phones/tablets and consumer products). However, the question still remains, why is there still such a disparity in the market values? The Report Card’s raison d’être is to help address this seemingly apparent paradox.

Research Methodology

Questionnaires were e-mailed to 90 selected individuals in the Roger Grace Associates data base who have and continue to play major roles in the MEMS commercialization process. These expert participants represented a broad range of MEMS manufacturers, users

of MEMS as well as individuals who represent companies engaged in MEMS infrastructure e.g. foundries, design software and equipment providers. Academics were not included in the research universe.

The participants represented a worldwide universe with the majority of the respondents coming from the US and Europe. The members of the research universe were asked to rate the 14 critical success factors/topics using grades "A" through "D" using plusses and minuses where applicable. Additionally, they were asked to provide specific comments a.k.a. verbatims as to the rationale of their assigned grades.

The 35 respondents had a collective experience of over 750 years averaging out to approximately 25 years per respondent. Follow-up interviews were also conducted to obtain specific information on the rationale for the submitted grades. Suffice it to say that this was an exceptionally well-experienced and well-qualified group of participants, a.k.a., experts. This research approach, known as Delphi, provides the best possible insight into a research topic where a statistically-significant and projection-able approach is not feasible.

Results

Figure 1 provides the letter grade results of the 2018 MEMS Commercialization Report Card on a yearly basis from 1998 to 2018. It also provides the change in grade from the 2017 to 2018 grades while Figure 2 provides a bar chart of the grades. The 2018 Report Card provided an overall grade of B- to the 14 critical success factors for MEMS commercialization. The overall grade did not change since 2010. More importantly however, was the change in the individual grades.

MEMS 2018 COMMERCIALIZATION REPORT CARD

SUBJECT / YEAR	98	99	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Δ
R&D	A	A	A	A	A	A-	A-	A-	A-	A-	B+	B	B	B+	B	B	B	B	B+	A-	A-	0
Marketing	C-	C	C+	C+	C+	C	C	C+	C+	C+	C+	C	C	C+	C+	B-	B-	B	B	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-	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+	-1
Established Infrastructure	C+	B	B+	A	A	A	A	A-	A-	A-	B+	B+	A-	A-	A-	A-	A-	A-	A-	A-	A-	0
Management Expertise	C	C	C+	C+	C+	C+	C+	B-	B-	B	B	B	B	B	B	B	B	B	B	B	B	0
Venture Capital Attraction	C	B-	B+	A	C	C-	C	C+	C+	C	C-	D	D+	D+	D+	D+	D+	D	D	D+	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+	0
Profitability	C-	C-	C-	C-	C-	C-	C-	C	C+	C	C-	D+	D	C-	C	C+	C+	C	C-	C-	C	1
Industry Roadmap	INC	B-	B	B+	A-	A	A	B	B-	C+	C-	C-	C	C	C	C+	B-	C+	C	C-	C	1
Industry Association	INC	INC	INC	B	B+	B+	B+	B	B	B+	B	B	A-	B+	B+	B+	B+	B+	A-	B+	B-	-2
Standards	INC	INC	INC	INC	C	B-	B-	B-	C+	C	C	C	C+	C	C	C+	B-	C+	C-	C-	C-	0
Employment	INC	INC	INC	INC	INC	C	C	C+	C+	C+	C	C-	C	C+	C+	C+	B-	B-	B	B	B	0
Cluster Development	INC	INC	INC	INC	INC	B	B+	B+	B	B-	C+	C+	C+	C	C+	C+	B-	C+	B-	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-	0

Fig.

1: The MEMS Industry Commercialization Report Card, established in 1998, annually provides objective and measurable details of the performance on a graded scale of the 14 critical success factors for the successful commercialization of MEMS. The overall 2018 grade was B- with changes in several of the topics from their 2017 level.

Out of the 14 topics, R&D and Established Infrastructure had the highest grade of A- and Venture Capital Attraction and Standards had the lowest grade of C-. Three topics increased one grade level, Venture Capital Attraction(C-), Profitability (C) and Industry Roadmap (C). One topic, Design for Manufacturing decreased one grade level to B+ (but just barely) and Industry Association decreased two grade levels to C-. The remaining nine topics remained constant from their 2017 levels.

The lowest C- grades established that Venture Capital Attraction and Standards continues to need major improvement and may be critical items in restraining the MEMS industry from realizing its true potential. In 2018, Venture Capital Attraction has finally emerged from its D level since 2009 when the world wide crises hit our economy and regrettably, venture capital monies have been targeted to software and social media startups. This is changing and a future article will address details of this.

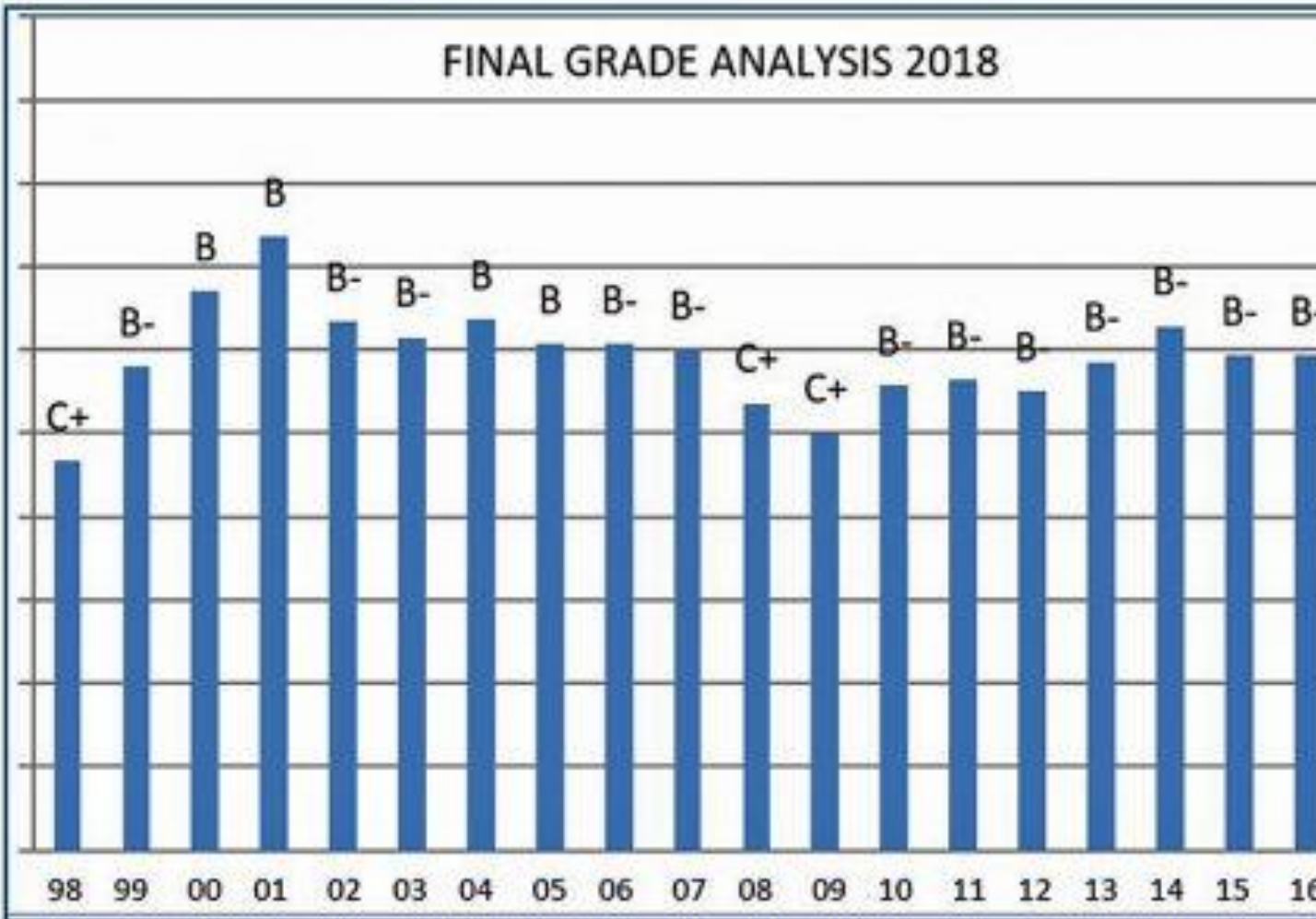


Fig.2: Since its inception in 1998, the MEMS Industry Commercialization Report Card assesses the performance of the MEMS industry with letter grades from A to D. The overall performance grade began at C+, improved to the B/B- level, decreased to C+ during the worldwide financial crisis (2008/2009) and has maintained a B- grade since 2010.

Fig.2 Since its inception in 1998, the MEMS Industry Commercialization Report Card assesses the performance of the MEMS industry with letter grades from A to D. The overall performance grade began at C+, improved to the B/B- level, decreased to C+ during the worldwide financial crisis (2008/2009) and has maintained a B- grade since 2010.

Summary

I believe that the objective of the 2018 annual MEMS Industry Commercialization Report Card of providing a valuable tool for MEMS industry participants to objectively monitor the health of the MEMS industry has been realized once again. I strongly recommend that MEMS industry participants should embrace the famous George Santayana quotation: “Those who cannot remember the past are condemned to repeat it.”⁽¹⁾ The results of the 2018 Report Card should provide industry participants with valuable information to effectively help craft their business strategies moving forward to create successful outcomes.

You Need To Learn More

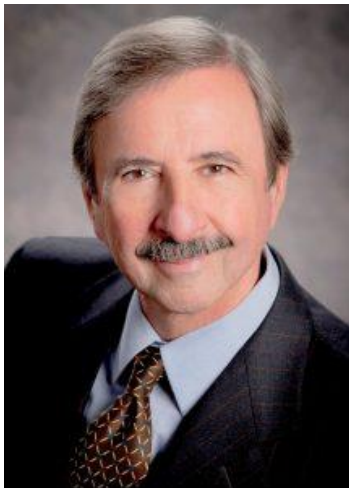
For a more comprehensive look at the 2018 MEMS Industry Report Card, I recommend a visit to [Roger Grace Associates](#). There you will be able to access more information including verbatim responses of the participants on each of the 14 topics. Also, the 2018 MEMS Industry Commercialization Report Card will be presented at the [Sensors Global Summit](#) in San Diego from December 10-12.

Upcoming issues of [Sensors Daily](#) will include additional articles on the Report Card addressing topics that include Design for Manufacturing and Test, Clusters, Industry Association, VC Funding, and Standards. Be sure to sign up for [Sensors Daily Newsletters](#) and visit [Sensors Daily](#) to stay on top of the latest products, technologies, and design tutorials and news.

REFERENCE

^[1] G. Santayana, Reason in the Common Sense, Volume 1 of the Life of Reason, 1905.

About the Author



Roger H. Grace

Roger H. Grace is president of Roger Grace Associates, a Naples Florida based strategic marketing consulting firm specializing in high technology. Founded in 1982, it provides custom market research, integrated strategic marketing communications, M&A due diligence and distribution channel advisory services. His clients include the international “Who’s Who” of corporations, federal laboratories and government agencies. His background includes over 40 years in high frequency analog design engineering, application engineering, project management, product marketing, and technology consulting.

Roger’s 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 U.C. Berkeley. He has specialized in sensors and ICs for over 35 years with a focus on micro electromechanical systems (MEMS). He has authored over 75 technical papers and articles, organized, chaired, and spoken at over 50 international technical conferences.

Roger is frequently quoted as an industry expert in major international technical and business publications on the topic of technology commercialization. He was the co-founder, past president, and currently is the Vice President of the Americas of the Micro, Nano and Emerging Technologies Commercialization Education Foundation (MANCEF), and has served on the Board of Directors of the Florida Manufacturing Extension Partnership from 2008 to 2014.

Mr. Grace has also served on the advisory boards of Northeastern University's School of Engineering, National Council, and Nanomanufacturing Research Institute as well as on the University of Michigan's Wireless Integrated Microsystems and Sensors Center (WIMSS) Strategic Advisory Board. He was selected as a recipient of the Outstanding Engineering Alumni of the Year in 2004 by Northeastern University. He was bestowed the inaugural Sensors Industry Impact Award in 2014 by Sensors Magazine. Mr. Grace held the position of visiting lecturer at the University of California at Berkeley School of Engineering from 1990 to 2003. For more details, contact Roger grace via email at rgrace@rgrace.com and visit his website, **Roger Grace Associates.**