

BARRIERS TO THE SUCCESSFUL COMMERCIALIZATION OF MEMS: THE 2013 MEMS INDUSTRY REPORT CARD

MEPTEC MEMS CONFERENCE
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Roger H. Grace
President, Roger Grace Associates
rgrace@rgrace.com
www.rgrace.com

ROGER GRACE ASSOCIATES

- Founded in 1982
- Offices in Naples, Florida and San Francisco, California
- Over 30 Years of experience in the MEMS/Nano industry...an industry pioneer
- International clientele of companies, laboratories and governments
- Specializing in sensors, semiconductors, MEMS/MST, Nanotechnology, capital equipment
- Focus on:
 - custom market research
 - strategic marketing
 - due diligence analysis
 - company and product positioning, branding, and promotion
 - business development
 - distribution channel development
- For more information...www.rgrace.com; rgrace@rgrace.com

ROGER GRACE BACKGROUND

- Education: BSEE, MSEE (Raytheon Graduate Fellow) Northeastern University, Boston, MA; MBA Program, University of California Berkeley
- Design Engineer with specialty in microwave and RF, 13 years...Raytheon, Avco
- Applications Engineer, RF semiconductors, 3 years, Avantek/HP
- Marketing Manager, MEMS, 3 years ,Foxboro ICT
- Marketing Consultant, MEMS, Sensors and Semiconductors, 30 years
- Guest Lecturer, University of California Berkeley, 1990-2003
- Alumni Engineer of the Year, 2004, Northeastern University
- Co-Founder and Past President of Micro and Nanotechnology Commercialization Education Foundation (MANCEF)
- Published over 50 papers and articles on MEMS/Sensors
- Organized and Chaired over 30 technical sessions worldwide on MEMS/Sensors
- Board membership...Florida MEP, University of Michigan WIMSS, Northeastern University High Rate Nanomanufacturing Center
- Organizing committee includes Transducers 2009, COMS, Smart Systems Integration (EU), Advanced Microsystems for Automotive Applications (EU), IRISS(EU)
- Citizenship...US/Portugal

OUTLINE

- Situational Analysis
- MEMS Commercialization Timetable
- Market Research Background
- Market Research Methodology
- Study Results
- Critical Success Factors
- Summary
- Call to Action / Recommendations

BARRIERS TO COMMERCIALIZATION

SITUATIONAL ANALYSIS

- Only until recently... plagued by the lack of high-volume applications
- Lack of well defined direction from roadmaps, industry standards, industry associations
- Multidisciplinary knowledge is required
- Packaging and testing costs typically at 70% of total value...however focus has been (and continues to be) on devices not systems solutions
- Lack of focus on customer needs...technology- centric suppliers... Technology push versus market / applications pull strategy
- Lack of capital formation opportunities, risk averse investors; low IPO opportunity because of small sales volume levels of companies
- Successive “bubble busts” i.e. biomems, optical telecom...wary investors
- Very fragmented market, many small companies, few large players
- Limited “success stories” of MEMS/MST companies e.g. Invensense
- However...new market opportunities for large volume applications have emerged in Automotive e.g. gyros, pressure ; Consumer e.g. oscillators, microphones, gyros, accelerometers, displays; Point-of-Care Diagnostics; Analytical Instruments ; Infrastructure Monitoring; Internet of Things (IoT)

MEMS COMMERCIALIZATION TIME TABLE

Product	Discovery	Product Evolution	Cost Reduction	Full Commercialization	Elapsed Time in Years
Pressure Sensors	1954-1960	1960-1975	1975-1990	1990	36
Accelerometers	1974-1985	1985-1990	1990-1998	1998	24
Gas Sensors	1986-1994	1994-1998	1998-2005	2005	29
Valves	1980-1988	1988-1996	1996-2002	2002	22
Nozzles	1972-1984	1984-1990	1990-2002	2002	24
Photonics/Displays	1980-1986	1986-1998	1998-2005	2005	25
Bio/Chemical Sensors	1980-1994	1994-2000	2000-2015	2015	35
Radio Frequency (R.F.)	1994-1998	1998-2001	2001-2014	2014	20
Rate Sensors	1982-1990	1990-1996	1996-2008	2008	26
Micro Relays	1977-1993	1993-1998	1998-2014	2014	37
Oscillators	1965-1980	1980-1995	1995-2013	2013	48
Median	10 yrs.	8 yrs.	12 yrs.		30 yrs.

MARKET RESEARCH BACKGROUND

- Initiated in 1998 during Hilton Head Conference
- Determination of 14 critical success factors established after investigation of various other industries (9 initial and 5 added over time)
- Everyone? likes grades...people can easily relate...e.g. NY Department of Health grades restaurants regarding their cleanliness, Zagat Restaurant Guides, Michelin Restaurant Stars, AAA Diamonds
- Objective is to monitor and report on the “health” of the MEMS industry in hopes of creating and influencing positive change...not only by conducting the research but by “evangelizing” via presentations and articles

MARKET RESEARCH METHODOLOGY

- “Delphi” approach used...not statistically significant i.e. non-projectable... however constitutes the opinions and rationale (via verbatim comments) of MEMS industry leaders
- Emails sent to 378 personally known MEMS industry leaders with 87 responses (23% return rate). Industry average response rate is approximately 3%.
- Two follow up mailings. (I did not vote)
- Follow up telecons with numerous respondees
- Research period from Jan.7, 2014 to Mar. 24, 2014
- Interviewees represented collective MEMS experience of > 1700 years
- International in scope with majority of respondents in N. America /Europe
- Broad selection of interviewees...suppliers, users, infrastructure providers
- Incentive of two- \$100 AMEX gift cards

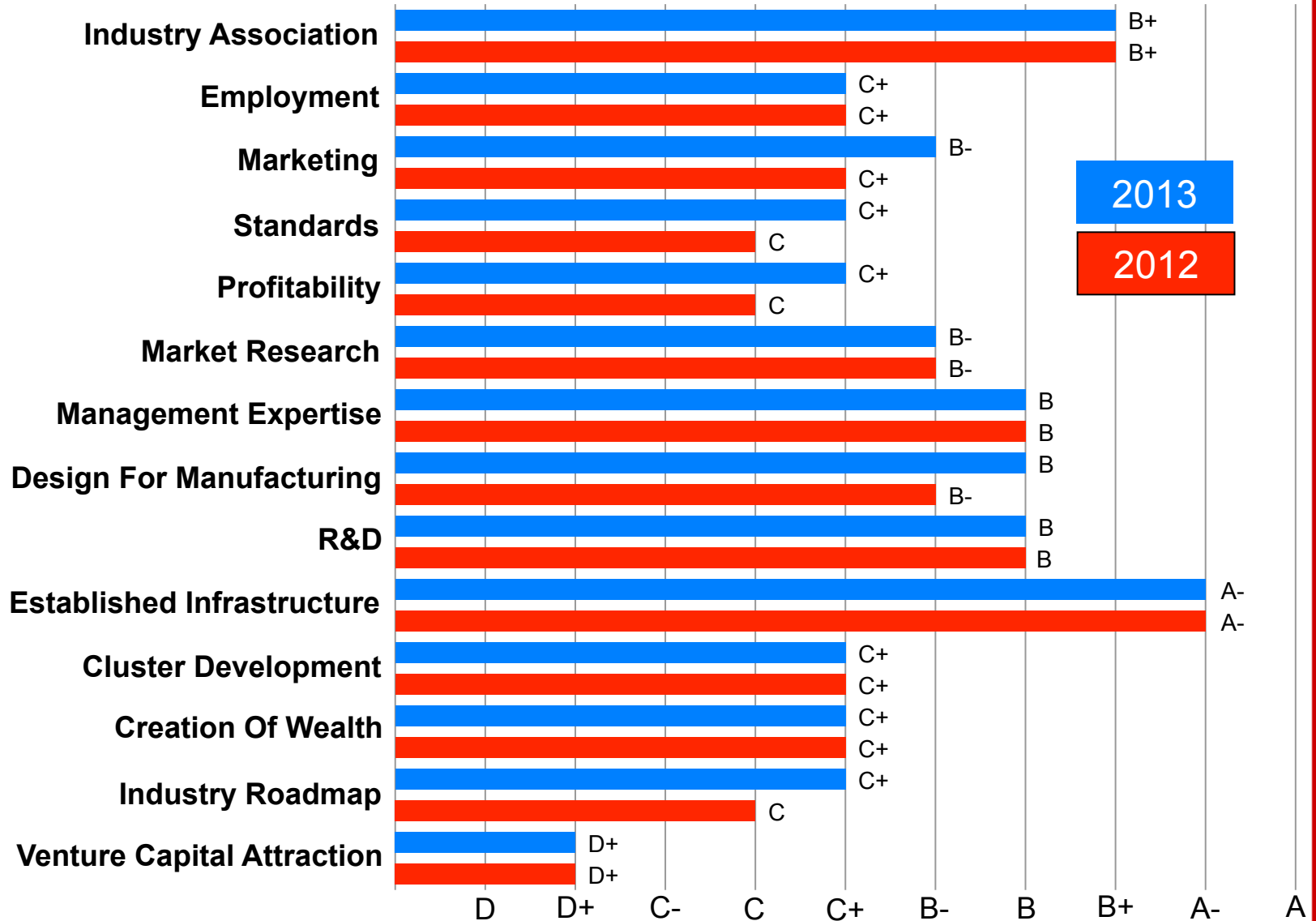
STUDY RESULTS

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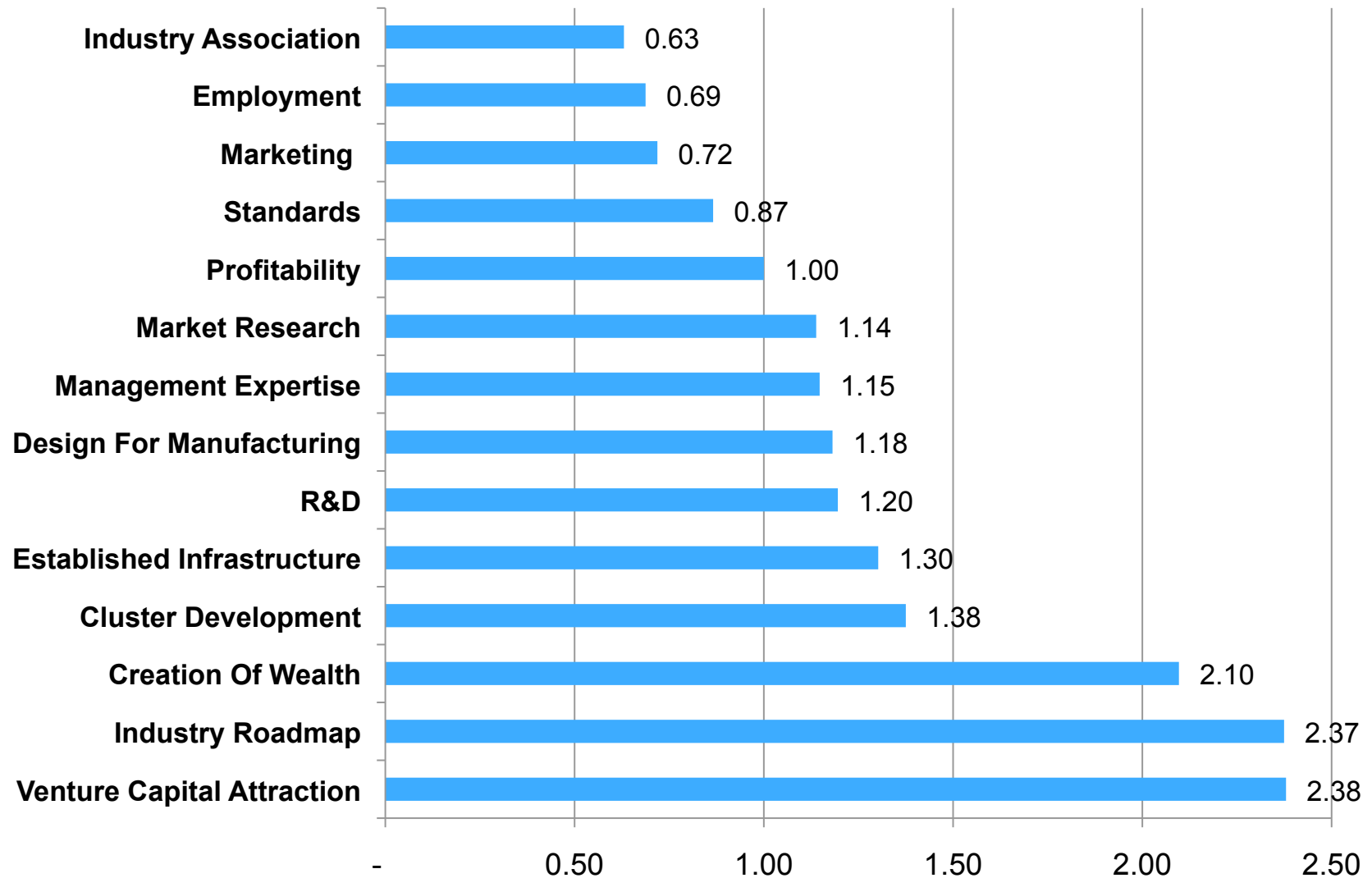
2013 MEMS COMMERCIALIZATION REPORT CARD

SUBJECT	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	Δ	SD
R&D	A	A	A	A	A	A-	A-	A-	A-	A-	B+	B	B	B+	B	B	0	1.6
Marketing	C-	C	C+	C+	C+	C	C	C+	C+	C+	C+	C	C	C+	C+	B-	+1	1.8
Market Research	C	B-	B-	B-	B	B	B+	B-	B	B	B	B+	A-	B	B-	B-	0	1.4
Design For Manufacturing	C+	B-	B	B	B	B	B	C+	B-	B	B+	A-	A-	B+	B-	B	+1	1.6
Established Infrastructure	C+	B	B+	A	A	A	A	A-	A-	A-	B+	B+	A-	A-	A-	A-	0	1.5
Management Expertise	C	C	C+	C+	C+	C+	C+	B-	B-	B	B	B	B	B	B	B	0	1.8
Venture Capital Attraction	C	B-	B+	A	C	C-	C	C+	C+	C	C-	D	D+	D+	D+	D+	0	1.5
Creation Of Wealth	C	B-	B+	A	C	C-	C-	C-	C-	C	C-	D+	C-	C+	C+	C+	0	1.9
Profitability	C-	C-	C-	C-	C-	C-	C-	C	C+	C	C-	D+	D	C-	C	C+	+1	1.8
Industry Roadmap	INC	B-	B	B+	A-	A	A	B	B-	C+	C-	C-	C	C	C	C+	+1	1.8
Industry Association	INC	INC	INC	B	B+	B+	B+	B	B	B+	B	B	A-	B+	B+	B+	0	1.6
Standards	INC	INC	INC	INC	C	B-	B-	B-	C+	C	C	C	C+	C	C	C+	+1	1.8
Employment	INC	INC	INC	INC	INC	C	C	C+	C+	C+	C	C-	C	C+	C+	C+	0	1.6
Cluster Development	INC	INC	INC	INC	INC	B	B+	B+	B	B-	C+	C+	C+	C	C+	C+	0	1.8
Overall Grade	C+	B-	B	B	B-	B-	B	B	B-	B-	C+	C+	B-	B-	B-	B-	0	NA

2013 MEMS COMMERCIALIZATION REPORT CARD



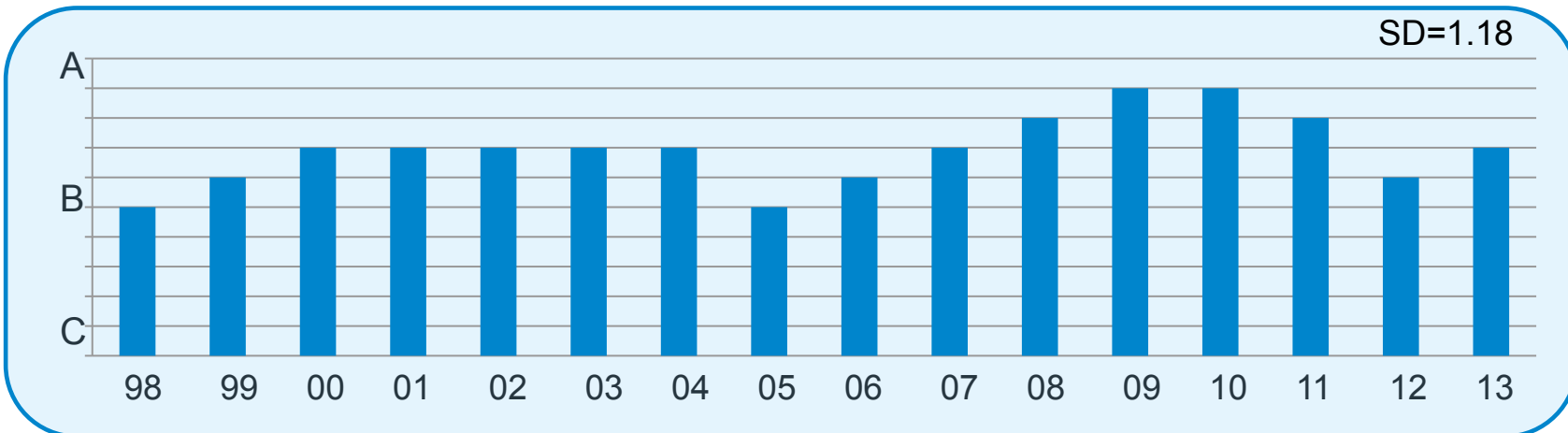
SUBJECT STANDARD DEVIATIONS (1998-2013)



VERBATIM MENTION SUMMARY

- Companies
 - STMicroelectronics 9
 - Invensense 9
 - Apple 7
 - Yole 6
 - Bosch 5
 - Google 5
- Organizations
 - MIG 31
 - Trillion Sensors 14
 - MANCEF 5
 - IEEE 3
 - MEPTEC 2
- People
 - Janusz Bryzek 2
 - Steve Nasiri 1
 - Bill Gates 1
 - Roger Grace 1

DESIGN FOR MANUFACTURING



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VERBATIM COMMENTS

- Too many MEMS companies are still using people without MEMS experience to develop their MEMS products. Without a knowledge of MEMS manufacturing issues, Design for Manufacturing can't be done. Some companies are doing this well, but there are still too many either doing it poorly or not at all.
- I think some of the larger companies in particular are focusing on this.
- the competitive landscape for end users of MEMS makes it imperative to promote design for manufacturing, to continue to drive costs down.
- Billions are sold = manufacturing seems under control.
- I believe this is getting better as toolsets are enabling rapid design for production.
- Prices are down, which must mean yields are up, which must mean DFM is working.
- CAD tools continue to get better. In particular, lumped model tools are getting much better.
- I think the infrastructure for MEMS manufacturing is maturing and there is much better understanding what is required to make a MEMS-based design in volume due to experience gained by the industry with the expansion of high volume products.
- As volumes increase and prices go down, manufacturability has become more important.
- **EMERGING HIGH VOLUME APPLICATIONS DRIVING IMPROVEMENT IN DFM**

DESIGN FOR MANUFACTURING

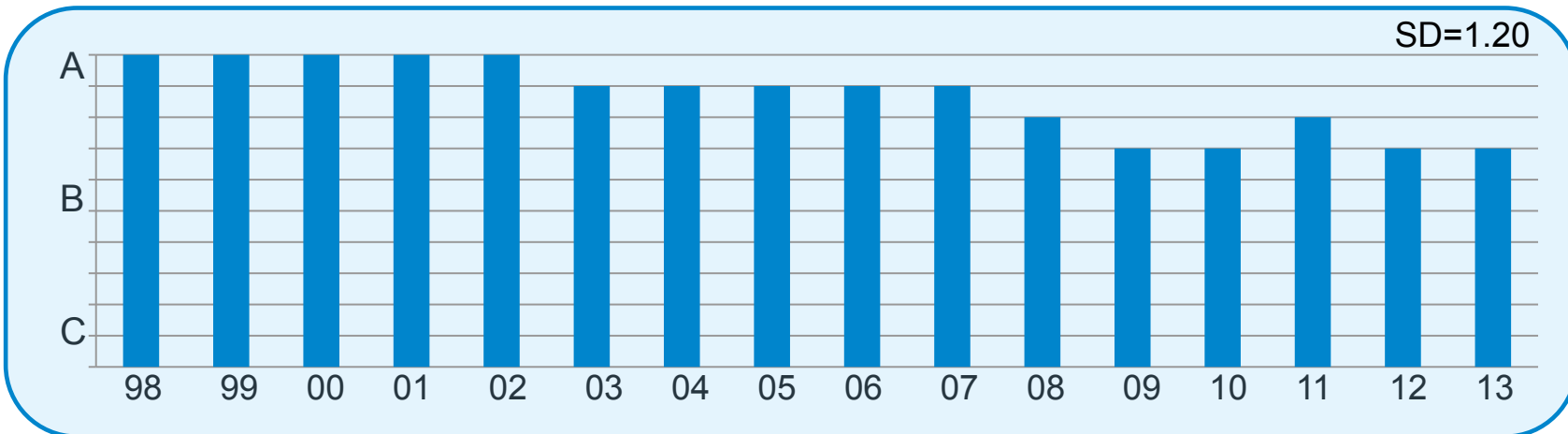
The way it was...

- Little to no concern for packaging and testing in initial design... purely an afterthought
- Small number of “killer apps”
- Packaging and testing not considered a major product differentiator
- Packaging and testing 60-70% of cost of manufacture

The way it is...

- Packaging and test integral in the design of virtually all high volume applications, co-design principles being adopted
- New and innovative e.g. wafer scale technology being adopted by high as well as lower volume applications but remain limited
- Packaging and testing now being considered as differentiators
- New approaches changing the paradigm of cost structure e.g. Invensense gyros, Freescale chip- stacking accelerometer, SiTime stacking ASIC/resonators, Ziptronix stacking chips in general

R&D



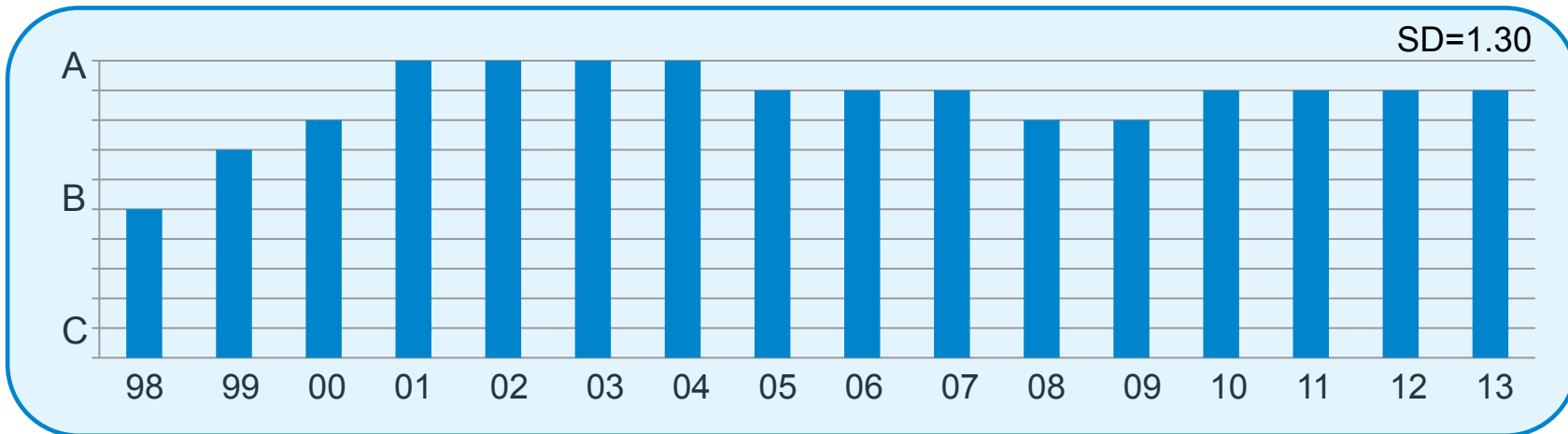
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VERBATIM COMMENTS

- Simply because more energy is going into commercialization and less into basic research, much of which has been done. It's never completely over, but is less of a focus than it might have been before.
- Front end MEMS has been heavily researched and developed. Backend MEMS packaging is researched and developed in pockets at a lesser rate with more coming (but struggling some).
- There is little pure research in MEMS that is exciting. A Lot of development work but no new breakthrough technologies being researched. A sign of a peaking industry.
- MEMS research is no longer hot for funding in an academic setting, where nanotechnology is currently the norm. It seems like most of the R&D is currently in industry and doing more development than research.
- I view 2013 as the start of a new golden age of R&D, driven by new apps like wearables, assisted driving, and microfluidics/implantables, as well as new advanced in fundamental materials like graphene.
- More and larger companies are becoming involved in MEMS development (Apple, Google, etc.).
- Federal funding is very uncertain and decreasing.
- R&D is being pushed a little to the background in favor or commercial product rollouts.

• **FOCUS APPEARS TO BE ON "small r" and "BIG D".DECLINING FEDERAL SUPPORT,NEW HOPE WITH ENTRY OF BIG PLAYERS E.G. APPLE,GOOGLE, INTEL**

ESTABLISHED INFRASTRUCTURE



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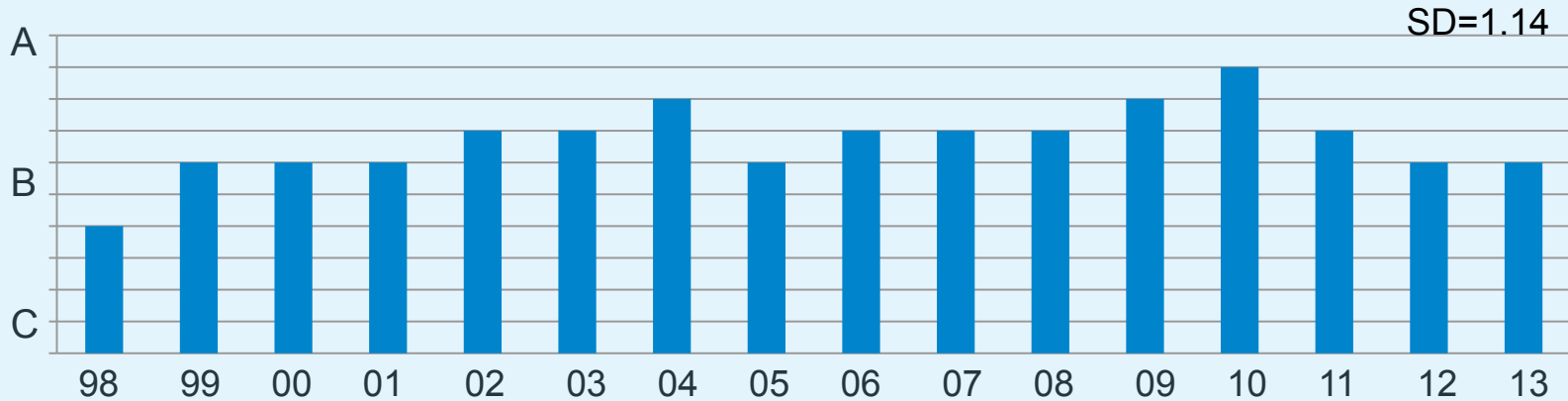
VERBATIM COMMENTS

- Equipment Companies, Foundries, Material Suppliers have all upped their game over the last decade to serve the MEMS industry. Large foundries are now entering the business. I think as the market grows, the infrastructure has improved alongside it.
- Great front end infrastructure. Backend and packaging infrastructure being put in place. Good trend.
- The demise of SVTC and AMS have hurt this.
- Participation by TSMC, Global and many assembly houses.
- Everything and more is now available from R&D to low cost high volume manufacturing.
- Front end infrastructure is good. Back end is poor.
- The move to 200 mm. is well established now and questions start to arise about 300 mm....
- If you are an established player, this is not an issue. But for a number of smaller and start-up companies, there is a lack of attention which is thwarting their growth.
- Testing vendors - not there. Packaging vendors - not there. Foundries - getting there, but lack of adoption of traditional MEMS processes.
- **ADEQUATE FRONT END FOUNDRIES..BACK END NEEDS IMPROVEMENT**

ESTABLISHED INFRASTRUCTURE

- The way it was...
- Little design software support...companies just beginning to enter market with limited software packages
- Manufacturing tools as a “home brew” approach
- High volume testing company just beginning e.g. ETEC
- The way it is...
- Software development and companies prolific e.g. Coventor, SoftMEMS, co-design principles being adopted
- Approximately 65 MEMS foundries worldwide to support 6”/8wafer production
- Manufacturing tools designed specific for MEMS e.g. Suss, Plasma- Therm, EVG
- Several MEMS- specific packaging / assembly companies in place e.g. Amkor, ASE, Smart Center (Ohio)
- MEMS- specific merchant market test companies still limited e.g. Acutronic
- establishment of MEMUnity ...www.memunity.org

MARKET RESEARCH

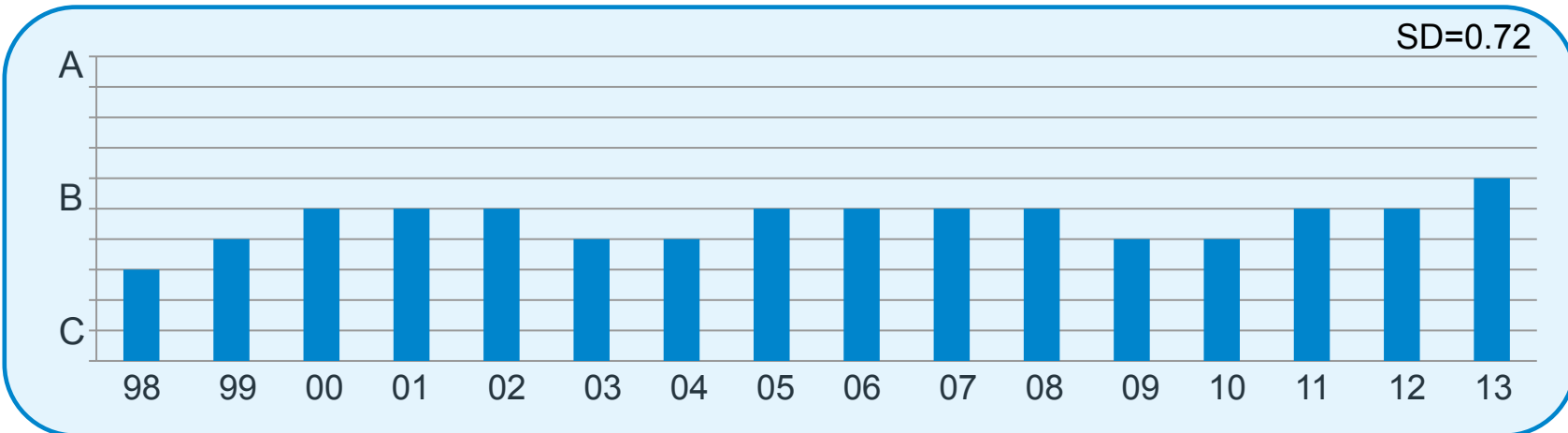


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VERBATIM COMMENTS

- Not reliable
- The MEMS industry does not do market research
- The MEMS industry doesn't do market research. They cite everybody else's research, but they don't invest themselves. They are willing to believe what ANYBODY tells them about market growth.
- Very good data available from Yole and HIS
- There is NO visibility on any new MEMS product areas.
- Except for a select few, most marketing analysts miss the next trends
- Good data on existing markets, no insight into emerging applications.
- Market research still focused almost exclusively on the hot area / high volume products of the moment.
- Market research organization still don't have vision
- Many specific market research groups have not been able to indicate new market developments there is a large need for in depth futurist development that only Roger Grace Associates and roadmap developers currently do.
- **MARKET RESEARCH FALLS SHORT OF MANY EXPECTATIONS / NO INSIGHT TO THE FUTURE / LARGE VOLUME MARKET FOCUSED (MOBILE)**

MARKETING

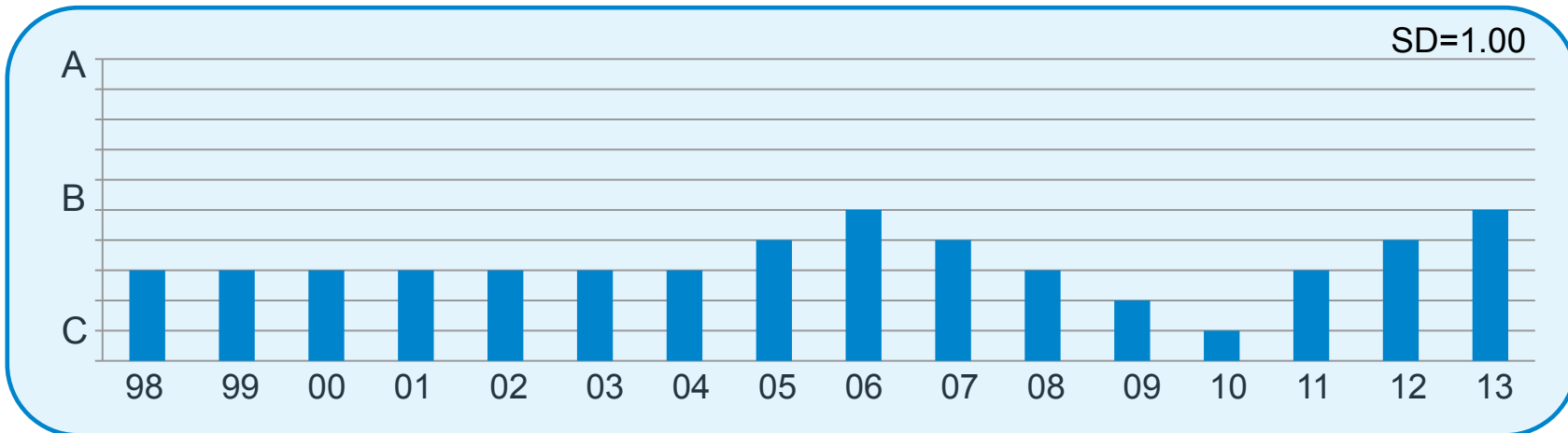


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VERBATIM COMMENTS

- Thanks to smart phones, users are aware of MEMS
- MEMS is not marketed, but rather individual products now, as the markets have matured beyond a technology sell.
- MIG has done a noteworthy job and deserves a higher grade. Companies like Invensense are aggressively marketing.
- Many companies lack visionary marketing, and as a result follow en masse the latest trends. As a result, there are a lot of similar products.
- Marketing will always be difficult since the application of the technology spans so many traditional markets.
- Still too much “herd mentality”...especially in the consumer segment
- MEMS seems to self market, little to no involvement in 2012
- Marketing resources are available in the industry. Not sure that companies developing unique solutions know how to approach unique marketing requirements.
- Marketing?...I don't see any MEMS marketing
- **MEMS MARKETING IS A OXYMORON / LIMITED PROMOTION BUDGETS / TALENT**

PROFITABILITY

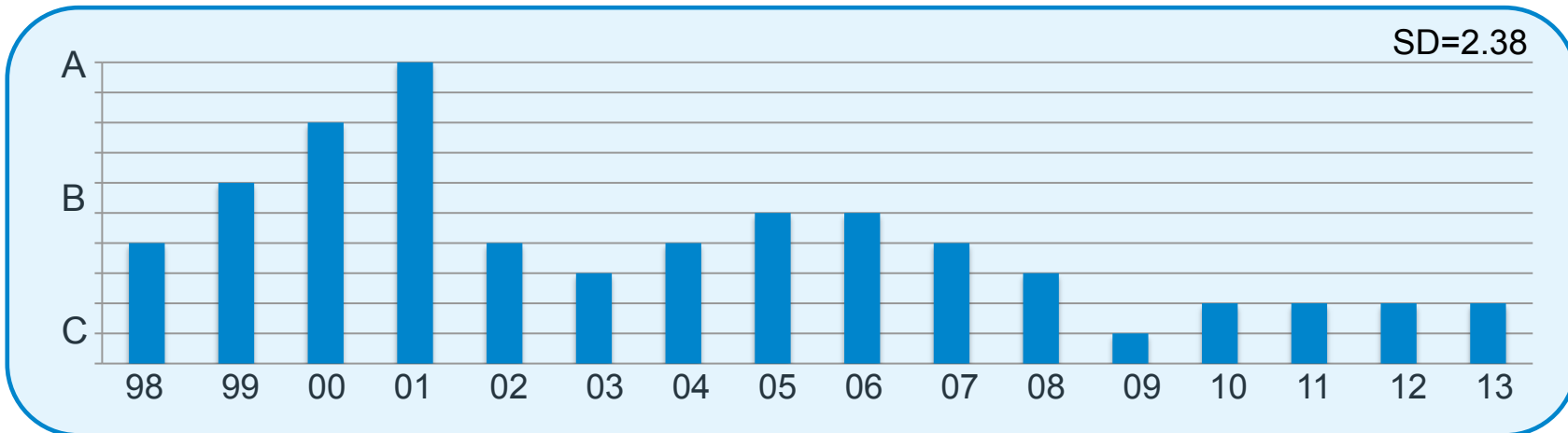


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VERBATIM COMMENTS

- This will come with more fortune 500 companies involved
- Good but declining as volume in Asia pushes margins into the basement. I predict that once Asian suppliers get there act together, it will slowly push out higher cost suppliers like ST and Bosch
- I believe that if you are in the right market segment...you can absolutely profit.
- Cell phone business is a race to the bottom in pricing. MEMS will never get good grades on profitability
- Margins are extremely low for many products and economies of scale do not always help.
- Major marketplace continues to have dramatic yearly price erosion.
- MEMS has been very profitable for some with this continually improving.
- This remains a tough area for most players, and it is one of the reasons why VC's are not interested in investing
- Many companies, including some longstanding ones, are finding it increasingly difficult to be profitable.
- Profitability has shifted away from component companies and into systems companies.
- Again a high volume device problem. With autos and cell phones being strong users, both of these industries are notorious for low price purchases.
- **HIGH VOLUME SUPPLIERS UNDER PROFIT SQUEEZE/SYSTEMS ARE THE SOLUTION**

VENTURE CAPITAL ATTRACTION

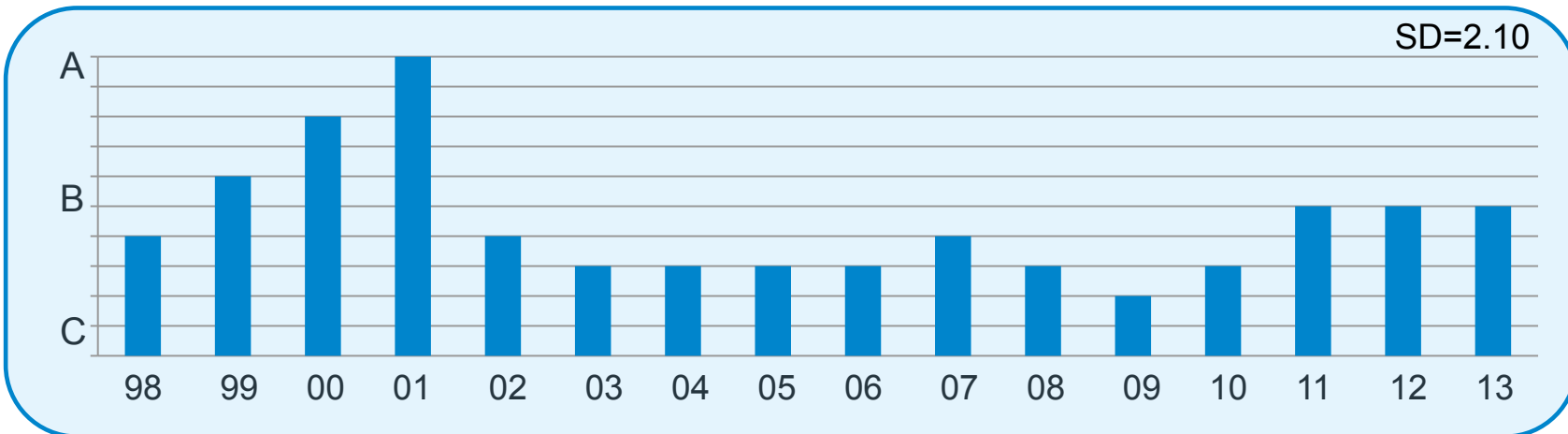


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VERBATIM COMMENTS

- **MEMS is not the only victim here as VC money for anything hardware related has decreased. However, due to low success rates, high capital requirements, and long timelines, new VC money going to MEMS companies seems to be almost non-existent.**
- **Poor record of results, historically. Now that there is something of a hockey stick, you'd think it might be more attractive, but VCs are off betting on internet/software plays.**
- **The industry has shown some ability to attract venture capital, but startup getting funding appear incredibly naive. And this drive VCs away in the future.**
- **Almost no interest from VCs on anything hardware related. Only corporate venture funds have shown recent interest.**
- **Angels and companies such as Invensense are picking up the slack.**
- **medical and bio apps seem to be attracting more interest.**
- **Venture Capitalists are still scared but their minds are opening to the potential as high volume opportunities are arising.**
- **MAJOR PROBLEMS ATTRACTING VC'S...NOT INTERESTED IN HARDWARE...BUT SOCIAL MEDIA. CORPORATE ACQUISITIONS THE TREND...FAIRCHILD, AMPHENOL, QUALCOM**

CREATION OF WEALTH

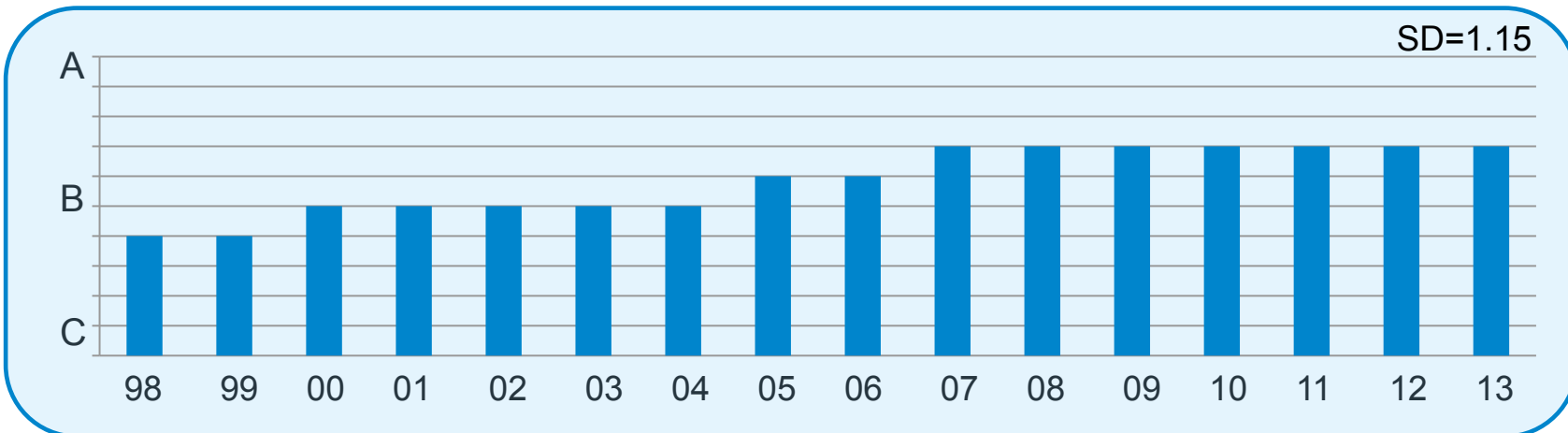


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VERBATIM COMMENTS

- It will definitely be creating wealth in the future based on the growing numbers of devices and applications.
- Supplier side improvements e.g. Invensense. Customer side flat or down e.g. Apple. Nest is a positive.
- It is difficult to start something new in the actual \"MEMS industry\" space. I think there are still good opportunities to create wealth through the applications that MEMS technology opens up.
- I still remember stories of secretaries at Microsoft becoming millionaires. But look at even the most successful MEMS business and there are very few rich men behind them. There are a few and recently seem to be some more, but this is still very low. Creation of wealth for individuals still seems fairly low, however, as an industry, a great deal of wealth has been created, and that is my reason for the increase in grade.
- No MEMS IPO has gone 50x yet
- At Invensense we created well over 100 multi-millionaires
- Compared to other industries, wealth creation in MEMS remains rare.
- Some MEMS companies have been acquired and people are making money.
- WITH RARE EXCEPTION (BUYOUTS)...\$\$\$\$ WILL CONTINUE TO BE DIFFICULT

MANAGEMENT EXPERTISE

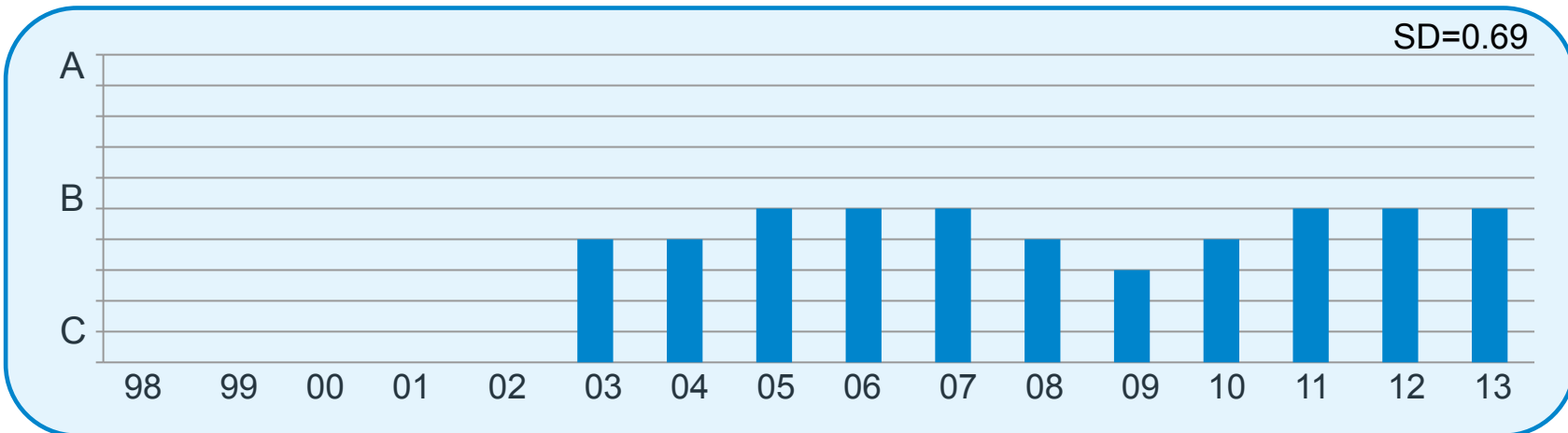


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VERBATIM COMMENTS

- It has to be getting better based on the industry age and increasing financial motivation to attract better talent in the future.
- MEMS companies still continue to put people in senior management positions with absolutely NO MEMS experience. This is absurd.
- Companies like Discera have had great opportunity but have failed the investors due to mismanagement.
- In general, corporate management still does not seem to understand the magnitude of the effort to bring MEMS products to market
- There are plenty of successful managers in the MEMS component fields across the globe. There isn't a glut, nor is there is good training available. Everyone must learn through the school of hard knocks, which is fine for those of us in a position of experience, but a challenge for those interested in becoming new program managers from other fields, or for new entrants.
- The managers are learning, but MEMS alone is not sufficient, the system level have to be considered to a large extent, because there are chances for more income if the selling quantities are not too high
- **THERE IS MUCH ROOM FOR MAJOR IMPROVEMENT HERE**

EMPLOYMENT



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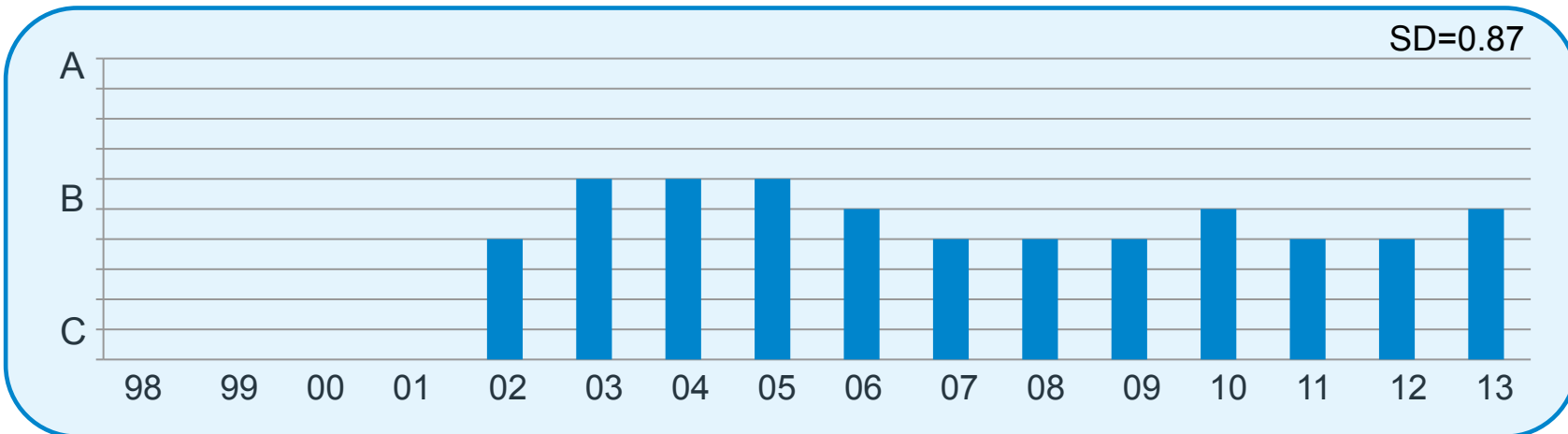
VERBATIM COMMENTS

- Slow but steady there will be more jobs added in the MEMS industry. The numbers demand it.
- Good news is low labor content (as a percentage of COGS). Need more R&D to increase employment.
- Stronger employment following recession.
- Back to the Apple, Samsung, Google and Microsoft example. More and more people are hired to design and produce MEMS than ever before that.
- Requests from companies are detached from reality. Talents are not paid sufficiently.
- I see more and more MEMS students landing jobs.
- MEMS don't require a lot of people due to the leverage of the fabless semiconductor industry and the foundry model. Lots of people aren't needed, and that isn't a problem.
- Still considered a niche market. But new emerging applications will bring this technology to the forefront as an important element to new products under consideration today opening up the employment numbers.
- Challenge to find good engineers with more than just academic background in MEMS. Again, this is what our industry association should be helping to improve.

LOOKING BETTER BECAUSE OF ECONOMY AND BIG DOGS ENTERING THE MARKET

E.G. APPLE, GOOGLE

STANDARDS

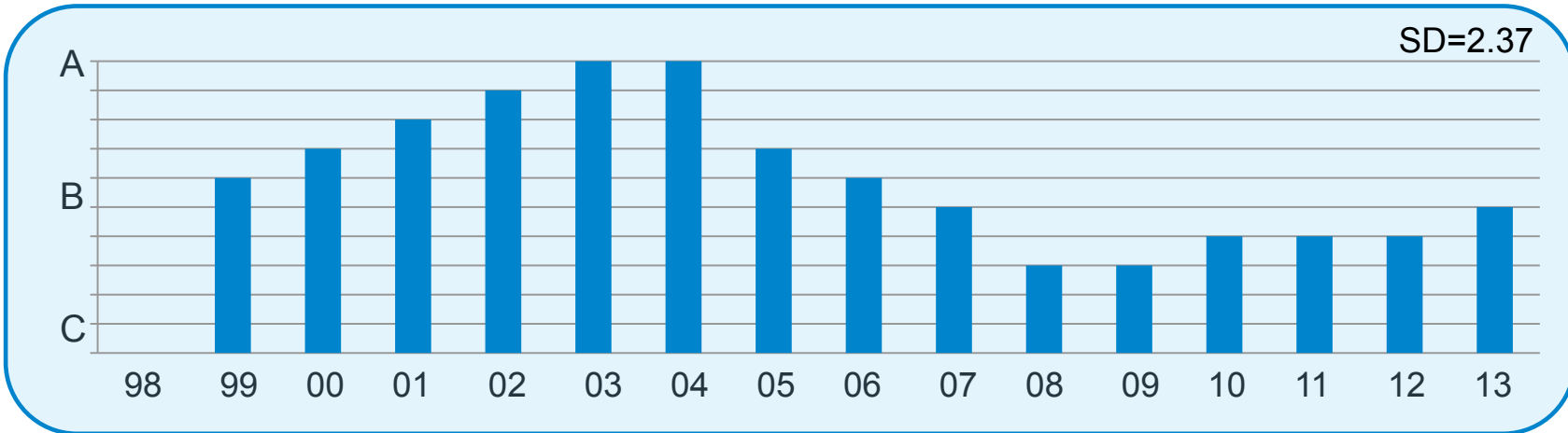


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VERBATIM COMMENTS

- At least things got started with standardizing some things around how specifications should look. A least it's a start.
- I'd have given it a D except for the incipient standards that are peeking their heads out.
- too many diverse products.
- Limited progress so far but the tide is changing. More people are getting on board. People who don't embrace it, will miss out on revenue and profit.
- For over a decade MEMS has been searching for standards. Where are they?
- QCOM and INTC did a good job on starting sensor standardization. Now to get broad industry backing
- Testing/ specification standards efforts gaining ground; INEMI taking up MEMS topics.
- Too many different application areas for a broad set of standards (this is not IC!)
- Standards? What standards? Enough said.
- The Testing standard issued in 2013 was a major step in the right direction
- **MEMS STANDARDS HAVE A LONG WAY TO GO TO BE ABLE TO HAVE ANY IMPACT ON COMMERCIALIZATION**

INDUSTRY ROADMAP

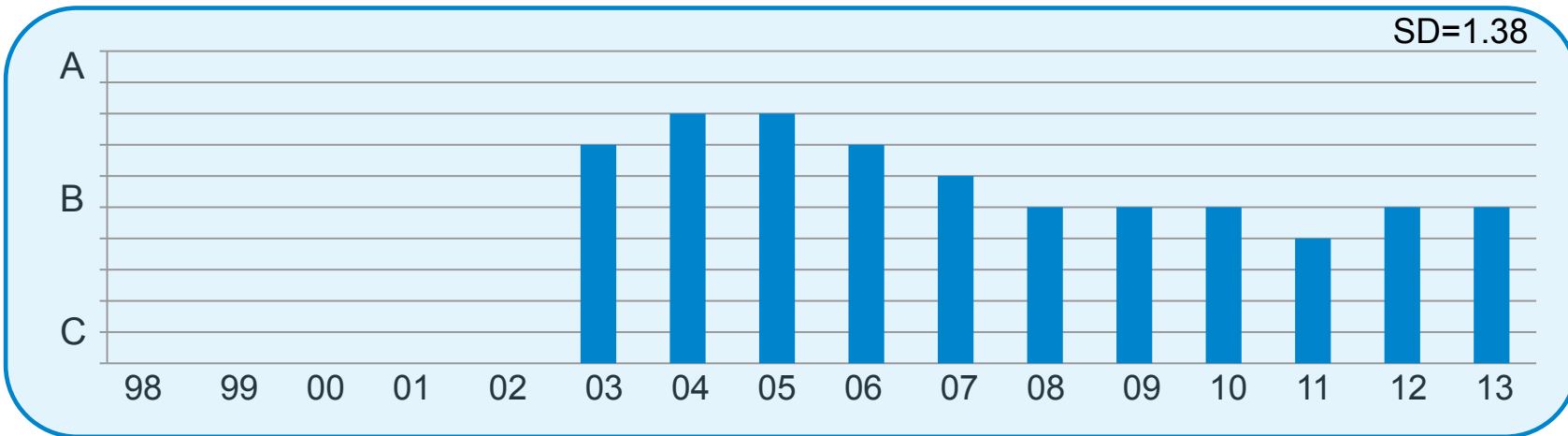


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VERBATIM COMMENTS

- Trillion Sensors showing promise and improving visibility.
- Because of the fragmented markets and products in the MEMS industry, roadmaps don't seem to be adequate. There are obvious directions like in inertial, more axes, lower power, lower cost. But outside of main established MEMS, it is very hard to set good roadmaps since many people don't seem to know which MEMS products are going to be the big successes.
- Existing roadmaps (MANCEF, ITRS) plus developing (TSensors) are working to point the way.
- MEMS is not an industry therefore there is no industry roadmap. Sensors and display, vision, health systems, auto, and more have clear roadmaps that help guide their future.
- Still too fragmented to have a technology roadmap but T-Sensors and INEMI are making first credible efforts.
- I have not seen one that I believe in.
- This is needed and has been for a while!!
- Difficult for MEMS as MEMS is a technology, not a product, and roadmaps generally require alignment to a specific application or market space. This is problematic for MEMS.
- **TRILLION SENSORS GAINING MOMENTUM...MIXED OPINIONS ON VALUE CONTRIBUTION**

CLUSTER DEVELOPMENT

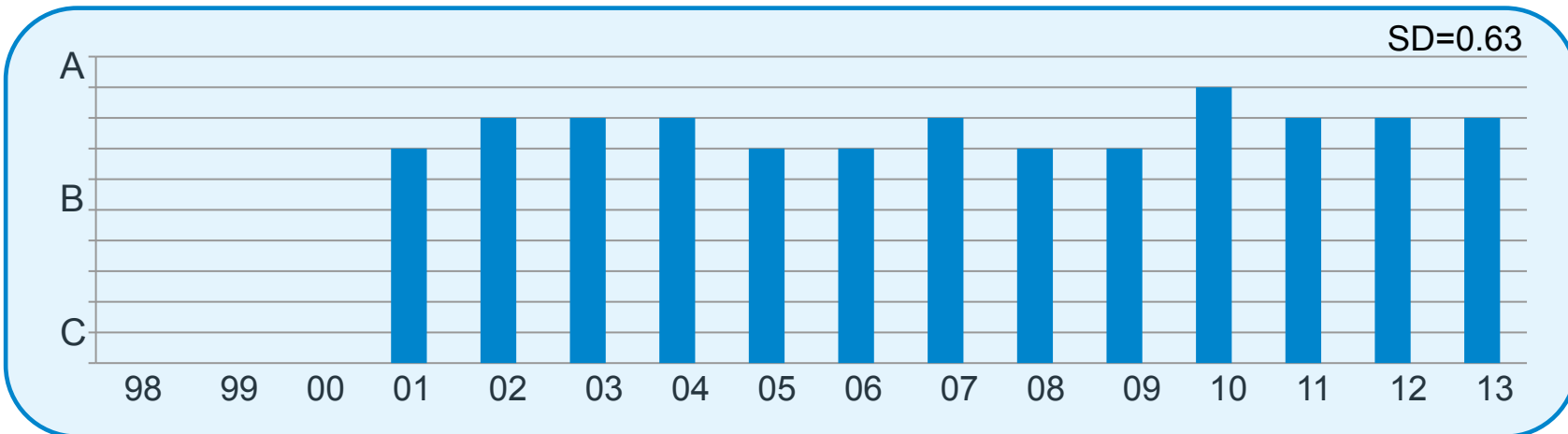


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VERBATIM COMMENTS

- Not sure what this means.
- This is closely related to the fact that MEMS is not a hot field for funding. Clusters may develop but including academia in it may prove difficult, unless we find new niches for MEMS.
- Europe is getting better, US is not.
- This is a concept that is well beyond the vast majority of management and decision makers, yet the power is unmistakable.
- Europe still leads in this area. But very little is happening in the US.
- Some clusters are forming but we need more.
- Clusters largely intact and growing slowly worldwide.
- Haven't heard any new news on this for MEMS. Other industries are benefiting. The MEMS Industry needs to lobby more.
- Efforts in Ohio and New York showing some growth.
- **THE CONCEPT AND BENEFITS OF CLUSTERS ARE RELATIVELY UNKNOWN BY MANY OF THE RESPONDENTS IN THE US...NEED MORE PROMOTION**

INDUSTRY ASSOCIATION

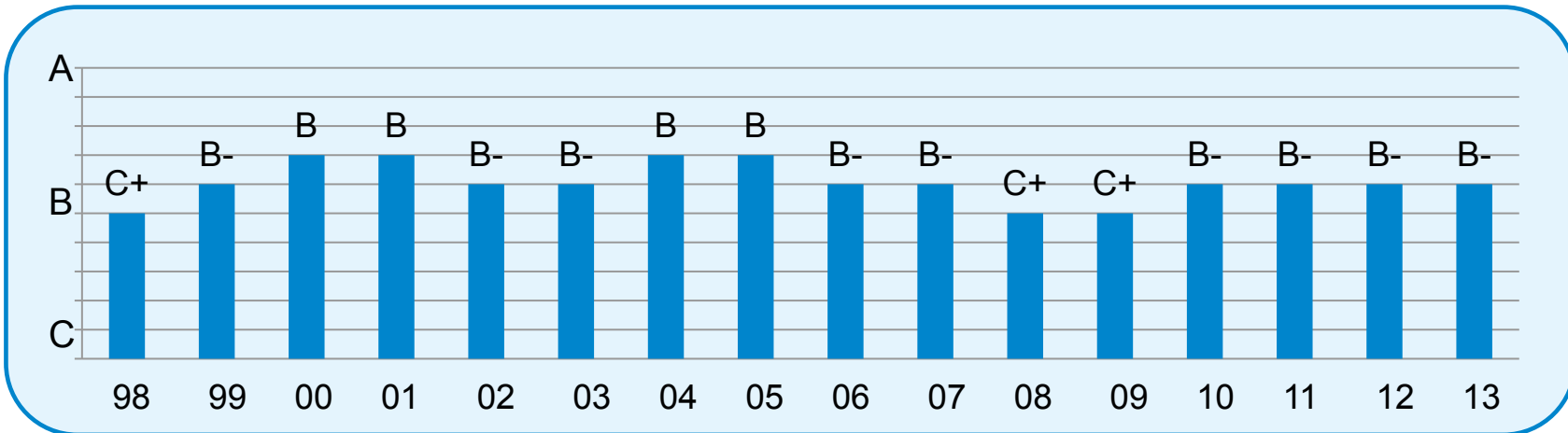


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VERBATIM COMMENTS

- The most prevalent industry association is the MEMS industry group. MIG has done a fantastic job growing and continuing to serve the industry. There are still things MIG can improve to help better serve the industry, and they likely will.
- Trillion Sensor roadmap and its linkage to other industry efforts should be making a difference.
- MIG has really established itself. Now T-Sensors becoming a virtual complementary association.
- The role of these associations might be less important now. Especially since they fail to attract end user participants.
- We have good events to network within the MEMS community, but we have yet to find a voice to reach outside the industry.
- MIG doing a good job but room for improvement.
- MIG has raised the awareness of MEMS more than anyone else. They bring people together to drive the needs for better standards, learning sessions and discussions concerning MEMS.
- MIG is very good but doesn't include users
- **MIG IS DOING A GOOD JOB / HIGH AWARENESS / ...ROOM FOR IMPROVEMENT..NEEDS TO ATTRACT USERS**

FINAL GRADE ANALYSIS / SUMMARY



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- The final grade for the 2013 Report Card remained at B- as it has for the previous three years
- Standard deviation of yearly grades =0.65 The overall grade stayed at “B-” from 2012 to 2013 with changes amongst the individual grades and with 9 grades remaining constant (versus 3 in 2011)
 - Established Infrastructure only subject to attain A status
 - R&D, Market Research, Marketing, DfM, Management Expertise, Industry Association, in the B’s
 - Standards, Creation of Wealth, Profitability, Employment and Cluster Development in the C’s
 - VC funding the only subject in the D’s...and continues to do so.
 - No negative changes
 - Positive changes (+1):Marketing, DfM, Profitability, Industry Roadmap, Standards
 - Standard deviations for subjects ranged from a low of 1.4 (Market Research) to 1.9 (Creation of Wealth)

MEMS still has a long way to go to meet the challenges of commercialization especially in the marketing and capital formation areas

Numerous “lessons learned” to date (and to be learned)from the semiconductor industry

CALL TO ACTION / RECOMMENDATIONS

- 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
- Define and establish defensible product differentiation
- Adoption of a marketing / applications pull vs. technology push strategy
- 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 / a better route is angels / industrial partnering / buy outs
- “Those who forget the past are condemned to relive it”...George Santayana...Reason in the Common Sense, 1905

UPCOMMING EVENTS OF INTEREST

- Sensors Expo* June 26/27 Rosemont, IL
- AMAA June 26/27 Berlin, Germany
- Trillion Sensors September 15/17 Munich, Germany
- MIG Exec. Congress* November 6/7 Scottsdale, AZ
- Trillion Sensors November 12/13 San Diego, CA
- Trillion Sensors November Japan
- IWLPC* November 11/12 San Jose, CA

*Roger Grace in attendance

תודה
Dankie Gracias
Спасибо شکرًا
Merci Takk
Köszönjük Terima kasih
Grazie Dziękujemy Děkojame
Ďakujeme Vielen Dank Paldies
Kiitos Täname teid 谢谢
Thank You Tak
感謝您 Obrigado Teşekkür Ederiz
Σας ευχαριστούμε 감사합니다
ขอบคุณ
Bedankt Děkujeme vám
ありがとうございます
Tack

A Copy of the PPT can be obtained at the Roger Grace Associates
Website...www.rgrace.com

Please feel free to contact me at rgrace@rgrace.com