

**Blog - MEMS New Product Development, Necessary Attributes of a MEMS Engineer for New Product Development, David DiPaola, DiPaola Consulting, LLC, [www.dceams.com](http://www.dceams.com)**

In the development of new MEMS products, the team is the most important factor. Executive management and investors will always evaluate teams and will only take large risks with teams that have earned their trust. In response to a question I asked Rich Templeton (CEO of Texas Instruments) regarding how he made the decision to invest in a new technology, a portion of his response highlighted the evaluation of and betting on teams. This is driven by the fact that it is actually quite common for engineers and entrepreneurs to lead multiple successful projects or startups over their career. With this in mind, let's review the necessary attributes that make these engineers and entrepreneurs so successful in MEMS new product development.

*Integrity:* This is the foundation upon which all other attributes are built. Truthfulness, consistency and accuracy of one's actions is of utmost importance as without it you have nothing. This is not something that is exercised in part or stretched. Its needs to embody who you are.

*Good Judgment:* An equally important attribute to integrity is a person's ability to exercise discernment. Its the skill of knowing what information is needed to make a sound decision, how to efficiently gather that information, being decisive and achieving positive outcomes a significant portion of the time. It also entails the ability to lead when large gaps in information exist and managing the associated risk. Engineers who use good judgment only reevaluate decisions for change as new information becomes available. Furthermore, they study given information, decisions made and outcomes to hone this skill over time.

*Details:* The details are what make products robust with ultra high reliability. A small detail can often make the difference in achieving or missing a specified performance target. For example, overlooking the use of a getter in a MEMS device with a vacuum cavity could result in output drift if materials out gas over time. Understanding the detailed physics of the problem at hand is also critically important.

*Ability to Learn:* Technology and human understanding of complex systems continues to evolve. In order to be successful, a individual must have the desire and ability to learn as new information becomes available. The MEMS industry is constantly changing with CMOS and nanotechnology integration, smaller feature sizes, optimized processes, standardization, sensor fusion and more. Those who are unwilling to learn from not only their work but the credible work of others will have difficulty producing competitive products.

*Problem Solving:* This is really a combination of proper methodology, attention to details and the ability to learn. Experts in a field that know the answer before they start, rarely solve problems. In running a design of experiments (DOE) of a MEMS sensor with a flip chip on flex laminated to a plastic substrate, pressure, time and heat were varied in an effort to eliminate voids in the laminate material and optimize process parameters. The first DOE resulted in multiple large voids over all parameters showing no noticeable trends. Through a methodology of identifying alternate factors and testing hypotheses, it was then discovered that moisture impregnated in the plastic substrate and flex circuit itself was actually introducing voids in the laminate as it out gassed during the lamination process. Once the moisture was removed either through a prebake or proper material handling, the voids were no longer present. A subsequent DOE was completed including moisture as a factor and the process was optimized. In a confirmation experiment, the predicted worst case process parameters resulted in large lamination voids and the optimized case demonstrated lamination with no voids and excellent adhesion.

*Motivation / Passion:* The drive behind peoples' actions and its alignment with project goals are essential. Are they doing it because they love it and in essence it is a part of their DNA or is it simply a paycheck? Does the subject matter wake them up in the morning because they can't wait to get started? Do their eyes light up, their voice become invigorated and their body language become expressive when they speak? Do off shoots of their passion migrate into their

personal time off? These are some of the characteristics that highly motivated and passionate people display. I had the privilege of discussing entrepreneurship and leadership with Ray Stata, founder and chairman of Analog Devices, a few years ago. Through words and action, his passion is intertwined throughout ADI. When their MEMS division was starting out and encountering difficulty, he showed his commitment to the business by becoming the general manager. He figured the company would not fire the founder although they could. In his spare time, he continues to show his entrepreneurial spirit as he lives vicariously through his investments in and mentoring of technology startups. Everyone I have spoken to at ADI speaks highly of him. Mr. Stata is an excellent example of the type of person you want on your team.

*Creativity:* The ability to think in new ways is extremely important. It's having the wherewithal to take an idea that appears crazy at the time and figuring out a way to make it work and provide a competitive advantage. Devices that provide outstanding function and have an elegant, eye pleasing package with a captivating yet easy to use interface exude creativity. An example of creativity in action is the first generation Apple iPhone. When it was first released, it revolutionized the smart phone approach and the smart phone leader at the time is still recovering after large market share loss.

*Experience:* When looking at job descriptions, the top requirement is often education level. This approach is not robust. Let me explain. If you were going to launch a MEMS device in production and wanted to hire an engineer, who would you choose: 1) A person with a bachelors degree in physics who launched several profitable MEMS products in millions of units per year successfully or 2) a person with a PhD in the subject matter of interest and an MBA with little industry experience? This is hypothetical but it illustrates a point. Education is extremely important but the method through which it is obtained is less critical and can take many forms. The CEO of Tumblr dropped out of high school in his freshman year because his school system had a weak computer science program. Instead he and his parents agreed for him to pursue his education through alternative, more productive channels. As recently highlighted in the news, he just sold his company for \$1.1 billion to Yahoo. He cites that he worked with and learned a tremendous amount from the smart people he surrounded himself with.

*Persistence:* The quality of steadily continuing despite difficult challenges along the way is a necessary characteristic of all accomplished engineers. People who are persistence are often mislabeled as stubborn. The key difference is persistent people listen to good reason and are cooperative. However, being cooperative does not mean going along with the direction from those in authority that logical reason and data shows is the wrong path. Instead staying the course and using influential communication with supporting data and analysis to gain needed support is a better approach.

*Communication:* Proper communication is not only used to transfer information but also to persuade doubters with good reason. This is an essential skill for interaction with customers, colleagues, investors and management. An engineer with good communication skills can explain a complex problem in a well articulated, concise and simplified manner without skipping critical details. In the end, the listener understands what was accomplished, how it was done, critical details and the resulting impact of the project.

*Influence:* Individuals in MEMS new product development will encounter resistance from various people along the way. This could be from management, investors or colleagues. Hence the ability of individuals to affect the thinking and actions of others through sound reasoning, credible data, persistence and convincing plans is necessary to bring MEMS products to fruition. For many years, there were critics who stated that standards for MEMS will never happen. Instead of accepting the status quo, engineers from Intel and Qualcomm with the support of MIG and other companies worked together to produce the first MEMS standard on sensor parameters. These actions are now influencing the MEMS community to accept that maybe some level of standardization is possible and beneficial.

*Risk Tolerance:* New product development and higher levels of risk go hand in hand. Engineers who take on this challenge, need to have a greater tolerance for this risk and be able to manage it. The key benefit of higher risk is the larger reward that is typically associated with it. With any new product development, there is always the possibility for cancellation, low adoption, project delays and insufficient funding. However, building teams on the principles above is the first step to lowering risk.

*Other Points to Consider:* When choosing a team leader, vision is another important factor to consider. Leaders with vision have the foresight to see the potential in an idea before it exists. Not all team members have to be visionaries but it is important that trust is built between those who have it and those who don't. In addition, carefully consider the chemistry when building a team. Having proper technical and business depth, meshing personalities and clear leadership is extremely important.

The team is essential for success in any MEMS new product development. Focusing on the key attributes mentioned above will help companies hire the best individuals for MEMS new product development. In next months blog, proper execution of MEMS validation will be discussed.

Updated Bio:



David DiPaola is Managing Director for DiPaola Consulting a company focused on engineering and management solutions for electromechanical systems, sensors and MEMS products. A 17 year veteran of the field, he has brought many products from concept to production in high volume with outstanding quality. His work in design and process development spans multiple industries including automotive, medical, industrial and consumer electronics. He employs a problem solving based approach working side by side with customers from startups to multi-billion dollar companies. David also serves as Senior Technical Staff to The Richard Desich SMART Commercialization Center for Microsystems, is an authorized external researcher at The Center for Nanoscale Science and Technology at NIST and is a Senior Member of IEEE. Previously he has held engineering management and technical staff positions at Texas Instruments and Sensata Technologies, authored numerous technical papers, is a respected lecturer and holds 5 patents. To learn more, please visit [www.dceams.com](http://www.dceams.com).