

"MEMS Product Development: A Foundry Looks at its Customers and the State of the Industry"

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1.0 Introduction

Developing a successful MEMS-based product has been a challenge over the past several years. The relative immaturity of the MEMS industry as compared to its more established cousins has made it difficult to successfully transfer a product from a conceptual phase to high volume production.

In essence, the challenge has been – and continues to be - to balance innovation with standardization in order to cost effectively develop breakthrough products.

Fundamentally, using MEMS technologies enables industrial components to be smaller, faster and less expensive. These are the necessary ingredients for creating breakthrough products and a significant amount of venture capital has been invested to develop MEMS applications for several different industry sectors. This has resulted in some product development successes along with a number of failures.

As an independent MEMS foundry based in Canada, Micralyne Inc. has worked with many companies in many industries over the past twenty years and has witnessed the evolution of the MEMS industry first hand. For Micralyne, the year 2005 represents a turning point as it is rapidly increasing its revenue base as major development projects have passed the threshold into volume production.

Is this turning point for Micralyne indicative of what is happening in the MEMS industry as a whole? Are the lessons learned by Micralyne relevant to other foundries and their customers? Several observations – from a 2005 perspective – are addressed below.

2.0 A Look at the MEMS Industry in 2005

A number of industry trends are having an impact on how new MEMS products are developed and these are influencing Micralyne's business activities along with those of its customers and competitors.

- **The “One Product – One Process – One Package” Method of Product Development**

Many MEMS product developers have succumbed to the “One Product – One Process – One Package” method of product development wherein industry-standard fabrication processes have not emerged. While the

application of MEMS to a broad range of target markets such as life sciences, telecommunications, and automotive is an indication of flexibility and innovation, the lack of standards may make product development programs more lengthy and costly as compared to other industries.

- **The Independent MEMS Industry is Quite Small**

The MEMS-based commercial products industry has been characterized as a multi-billion dollar field. This is an accurate statement for the industry as a whole but for the portion that is independently developing and manufacturing new products, the size is in reality quite small.

Yole Development has recently reported on the manufacturing revenues of the top 30 MEMS manufacturers in the world for 2005 (*Micronews; July, 2005 – No. 38*). These companies generated over US\$4 billion in total revenues from the manufacture of airbag and other automotive sensors, DLP mirrors, ink jet printheads and a few other device categories.

Of that amount, only roughly 2% of the total or 4-5 companies generating approximately US\$100 million in revenues are independent MEMS foundries. This is significant as most emerging MEMS applications are medium volume manufacturing opportunities with a high value-add component. These types of opportunities do not attract the attention of large or captive foundries and are left to independent foundry companies who in turn are relatively small and have limited resources. Compared to foundries in the semiconductor business, independent MEMS foundry revenue is a “drop in the bucket”.

This should not be a surprise for a relatively immature industry but expectations for the future and how much these independent foundries can invest in process development and capacity has to be aligned with their available resources.

- **Promotion of Industry Standards Are Not Worth the Time and Effort**

Industry standards have been a constant topic of discussion at most industry conferences. With the emergence of fabrication standards, it was thought the MEMS industry could emulate the rapid growth and success of the semiconductor industry. Unfortunately, the semiconductor industry is not completely analogous to the MEMS industry and pursuing standards may in fact stifle innovation.

As MEMS technologies can be applied to several different industry sectors with multiple interfaces (ie fluidic, optical, electrical, etc.) and most applications do not require high volume production as of yet, the MEMS industry, as it stands, is not conducive to the rapid acceptance of standard fabrication processes. Standards will likely emerge over the long-run but they will be established based on long-term product successes and forcing them upon the industry prematurely could prevent new and innovative applications from emerging.

- **“Killer Apps” May Never Appear**
As an industry, predictions of the next “killer applications” - or a product that is manufactured at very high volumes and generates massive revenues - have often been noted as the panacea for the MEMS industry. As attractive as they are, it is unlikely many killer apps will surface and most industry growth will result from smaller volume but higher value-add product opportunities. Industry stakeholders should therefore manage its expectations accordingly.
- **The Industry is Stabilizing**
The last five years can be characterized as a period of manufacturing overcapacity and the rapid rise and fall of several companies with a MEMS focus.

With the closure of several foundries and product companies (some in a spectacular fashion), the maturation of many processing capabilities, and the increased customer acceptance of and demand for MEMS-based products, the industry appears to be stabilizing and is attracting a number of new entrants.

3.0 A Look at Independent MEMS Foundry Customers

An analysis of projects at Micralyne running over the past 10 years suggests that a number of factors – regardless of industry or technologies used - contribute to successful and cost effective MEMS product development.

- **Customers Must Design Around a Foundry’s Processes**
To be a success in the short-term, MEMS application firms must design their products around a foundry’s existing, internal standard processes. By doing so, they will increase the probability of success as they can shorten development timelines and take advantage of more predictable yields from the start of production. In contrast, many companies today design their products without much thought to the fabrication details.

At the same time, the onus is on foundries to characterize their internal processes with sufficient statistical data that is made available to customers. It is also important to note that these internal process “standards” may not be translatable to other manufacturing facilities.

- **Customers Have to Undertake Due Diligence on Their Foundry**
As a venture capitalist undertakes due diligence on an investment opportunity, a MEMS product development company must undertake due diligence on their foundry partner. In particular, evaluating a foundry’s personnel is critical. For example, innovative engineers are crucial for innovative product breakthroughs; but these are not the same engineers who are needed to characterize repeatable, reliable manufacturing processes for volume production. While both may be trained professionals, those who create MEMS products differ greatly from those who manufacture them in volume. Many foundries have strengths in one area versus the other but a successful foundry must employ both.

A foundry partner must also have the control systems in place to bridge the gap between development and manufacturing environments. Strategies ranging from formal design reviews to on-line monitoring systems are critical to product development success. It is equally challenging to first capture innovation and then translate it into a set of standard and repeatable volume manufacturing processes.

- **Customers Must Educate Themselves**

The sophistication of customers varies dramatically in the MEMS arena. Customers must understand or be educated on the challenges of developing realistic timelines and budgets. Customers must also understand the paradigm of product development. That is, a customer ideally wants three things: a very high performance product, a rapidly progressing development program, and a very low cost. The reality in the MEMS field is that when faced with these three variables, the customer can only pick two.

4.0 Summary

Micralyne has experienced the ups and downs of the MEMS industry over the past several years but 2005 represents a period of increased operational stability and revenue growth. Industry stakeholders – both the foundries and their customers - are recognizing what the MEMS industry can accomplish (and its limitations). They also appear to have a more informed idea of what it takes to develop and launch a successful MEMS-based product. The question remains, however, of whether or not this new level of maturity will lead to a new era of industry-wide growth and financial success.