How to Successfully Transfer MEMS from a University Lab to a Commercial Foundry

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Overview

- About AMFitzgerald
- Are you ready?
- Choosing a foundry
- Transfer
Mission: Your Partner in MEMS Product Development

Company background

- Founded 2003 by Alissa M. Fitzgerald, self-funded

- Burlingame, CA: near SFO and Silicon Valley

- Consistent growth, over 100 clients served to date

- Active member of the MEMS Industry Group
**Our value**

- **First time developing MEMS?**
  - We can provide the complete solution

- **Improving your MEMS product?**
  - Let us optimize your design

- **Investing in MEMS?**
  - Valuable insight from expert practitioners

- **Our competitive advantage**
  - A complete MEMS solution
  - Expert design and process engineers

**A complete solution from concept to production**

- **Project management**
- **Multi-disciplinary engineering team**
- **In-house prototype fabrication (150 mm wafers) by our engineers, not operators**
- **Smooth transition to production partners**
- **Leverage our supplier ecosystem**
Are you ready to go to foundry?

- Yes, if you have:
  - Stable process flow and mask set
  - Budget (> $250K/yr.)
  - Order schedule for next 1-2 years (i.e. customers)
  - Cost targets

### ACME MEMS Order Schedule

<table>
<thead>
<tr>
<th>Production</th>
<th>Number of Wafers</th>
<th>Target $/Wafer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>500</td>
<td>$1500</td>
</tr>
<tr>
<td>Year 2</td>
<td>1000</td>
<td>$900</td>
</tr>
<tr>
<td>Year 3</td>
<td>1500</td>
<td>$700</td>
</tr>
</tbody>
</table>

Read the MIG Foundry Engagement Guide

- Written by a group of foundries and MIG members

**Big foundries (order > 100 wafers/year or > $250K/year)**

![TOP 20 MEMS Foundry ranking - Sales 2010](image)

(Yole Développement Estimates $M – April 2011)

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**Small foundries**

- **Will consider small orders (< 100 wafers/year)**
  - Micrel
  - Nanostructures
  - Advanced MicroSensors
  - MEMSCAP
  - MidWest MicroDevices
  - LioniX
  - Micronit (microfluidics)
  - MFI (MEMS Foundry Itzehoe)
  - MEMS Core
Not all MEMS will need 200mm wafers

Choosing your foundry

- The foundry is your partner in a long-term relationship
- Switching foundries = starting over ($$ and time)
- Take time and care to make a good decision!

"I think this is the beginning of a beautiful friendship."
First steps

- Sign Non-Disclosure Agreement
- Write RFQ “Request for Quote” document
  - Device drawings
  - Process flow
  - Test requirements
  - Order quantities, cost targets
  - Business case
- Send RFQ to multiple foundries
- Discuss details with foundry sales teams

The foundry quote

- Quote will be for Feasibility phase only, with rough estimates for Prototype, Pilot
  - NRE: masks, setup, shortloops
  - Wafers
  - Batch size minimum 10 wafers started
  - Priced per wafer or batch
  - No yield guarantees (“best efforts”)

- Typically – multiple Feasibility batches required before moving to Prototyping phase
Ramp to production timeline (with an existing prototype)

[Flowchart showing timeline with stages such as FOJNDRY, MEMS COMPANY, System development, Z loops, N loops, as needed: 12 weeks typ., Prototype wafer batches, Pilot qualification: six months minimum, Production, Continuous yield improvement, etc.]

How to get the best prices

- Low technical risk keeps NRE low:
  - Frozen design/process
  - Repeatable process

- Confirmed order quantities keep wafer prices low:
  - The more you order, the cheaper it gets

- Show a path to volume
  - Foundries want to crank out wafers, not do engineering projects
Making a decision

• Evaluate foundry’s process capability and experience with your type of product

• Make sure you have compatible:
  – Business models
  – Timelines
  – Expectations
  – Quality standards
  – Product volumes – ideally, don’t want to be smallest or largest customer

• Go for best fit, not lowest price

The foundry will be evaluating you, too!

• Are you a stable company?
• Are you well-funded?
• Do you have established customers?
• Do you know what you are doing?

• Present your business well, don’t make them dig for information
Closing the deal

- Price
- Contract terms
- Purchase order
- Downpayment

Successful technology transfer and ramp up

- Provide to foundry:
  - Die layout in .GDS
  - Runsheet, process data
- Dedicate an engineer to be foundry liaison
  - Transfer tech info to foundry
  - Monitor wafers in progress
  - Troubleshooting
  - Visit foundry
- Timeline and budget management
- To get the best results, be a teammate to your foundry
Rookie mistakes

- Only quoting one foundry
- Expecting to go to production in less than a year
- Not presenting a good RFQ or business case
- Throwing design “over the fence”
- Twiddling design/process
- Being underfunded
- Lack of communication with foundry

Summary

- Selecting a foundry is an extremely important business AND technical decision
- Don’t underestimate time and money involved

- We can help you!
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