Analysis of Value Creation and Value Capture in Microfluidics Market

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Agenda

- Introduction
- Technology
- Market Demand & Business Ecosystem
- Data Collection and Analysis
- Strategic Recommendations
INTRODUCTION
The Context
Literature Citations

Total Microfluidics/Lab-on-a-chip Market: Literature Citations (U.S.), 1997-2005

Frost and Sullivan, 2006

Source: Frost & Sullivan
Market Forecast

BCC Research, 2004
Experts’ Opinions

- Lack of killer application
- Significant Lag in Commercial Development
- Still in search of niche market
- FDA Regulation

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Motivation for further study

• Bring clarity to understanding of microfluidic innovation ecosystem by applying analytical frameworks
• Analyze the current state of value capture in microfluidics based on the collected data
TECHNOLOGY
Microfluidics

- An emerging technology which combines low volume fluidics, material science, chemistry and biology into a product ranging from ink-jet printer to diagnostic chip
Microfluidics Scale

Microfluidic Volume Range
(100 pl - 1 μl)

Microfluidic Channel Size Range
(10 – 200 μm)
Brief History

Timeline

Key Products

On-Strip Test Kits (for diabetes and pregnancy)

Silicon Wet Etching

Micro-electromechanical Systems (MEMS)

Silicon Micromachining

PDMS Micromolding

Ink-Jet Printer (HP ThinkJet)

DNA Separation System (CaliperLS LabChip)
A Typical Microfluidics System

A Typical Product Using Microfluidics

- Robotic Arm
- Injection Pump
- Sample In
- Sample Out (for offline detection and analysis)
- In-line Detection
- Analysis Software
- Channels
- Mixing Unit
- Reaction Unit
A Typical Microfluidics Process
Microfluidics Product

Raindance RDT1000

Droplet Generating Chip

Reagents

DNA Sample

Droplet containing DNA and Reagent

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Innovation Parameters

Key Innovation Parameters

- Sample Volume
- Number of Reactions

Technology Innovation Timeline
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80s 90s 2000 2010

- > 200 ul
- > 10 µl
- 192 Channels
- > 9216 reactions

- Continuous Microfluidics
- Integrated Fluidic Circuit
- HP Thinkjet
- Isolated micro-channels
- Droplet Microfluidics
- Fluidigm BioMark
- Raindance RDT 1000
S-Curves
MARKET DEMAND & BUSINESS ECOSYSTEM
Demand Generation

- Process Improvements
- Microfluidics Technologies
- Novel Applications
Customer Segments

- **Industry**
  - Diagnostics End-Users
  - Drug Discovery Companies

- **Academia**
  - Government
  - University Laboratories
  - Research Institutes

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Application Categories

- Genomics
- Microfluidics Technology
- Proteomics
- Drug Discovery
- Point-of-Care Diagnostics
Business Ecosystem

Users
- University Laboratories
- Drug Discovery Companies
- Research Institutes
- Government
- Diagnostics
  End-users

Flow of Financial Value ($)

Flow of Technology Innovation (✓)

Microfluidics Players
- Solutions Companies
  - Agilent Technologies
- Spin-offs
- University Laboratories
  - Weitz
  - Quake
- Whitesides
- Toolkit Companies
- OEM Vendors (Fluidic, Motion Control, Optics, etc)

Applications
- Drug-Discovery
- Proteomics
- Genomics
- Point-of-Care
  Diagnostics

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MIT SDM Systems Thinking Webinar Series
Value Flow Diagram
Key Factors in Diffusion & Adoption

- Availability of application
- Definition of market
- Maturity of technology
- Cost of implementation
- Advantage over current technology
- Adoptability
- Challenges in implementation
- User-friendliness
Roger’s Adoption Distribution Model

Number of Units Sold

- Innovators: 2.5%
- Early Adopters: 13.5%
- Moore’s Chasm: 34%
- Early Majority: 34%
- Late Majority: 16%
- Laggards

Time
DATA COLLECTION AND ANALYSIS
Data Collection Method

- Survey
  + Easiest way to reach a lot of people at once
  + 100 contacted (50% Academia, 50% Industry)
  + 17 Questions (mix of multiple choice, ranking and open-ended questions)
    - Participants Background
    - Technology Parameters
    - Application
    - Future of Microfluidics
Survey Statistics

- Survey Response
  - 38 responded (58% Academia, 42% Industry)
  - Fairly uniform distribution across major groups
    - Professor – 17%
    - Engineer/Scientist/Researcher - 37%
    - CEO/VP/Director/Manager – 23%
    - Student – 23%
  - 96% have decision-making responsibility
Primary Drivers of Interest

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>New Technology Exploration Effort</td>
<td>91%</td>
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<tr>
<td>New Applications Need</td>
<td>64%</td>
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<tr>
<td>Increase Throughput</td>
<td>52%</td>
</tr>
<tr>
<td>Reduce Reaction Cost</td>
<td>48%</td>
</tr>
<tr>
<td>Reduce Footprint</td>
<td>33%</td>
</tr>
<tr>
<td>Adoption By Peers or Competitors</td>
<td>12%</td>
</tr>
<tr>
<td>Research</td>
<td>9%</td>
</tr>
<tr>
<td>Integration</td>
<td>3%</td>
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</table>

Top two factors, *New technology exploration efforts* & *New application need* are also the needs of early adopters, who are *University Laboratories and Research Institutes*.
Ranking of Benefits

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faster analysis time</td>
<td>2.9</td>
</tr>
<tr>
<td>Low sample/reagent volume</td>
<td>3.3</td>
</tr>
<tr>
<td>Higher throughput</td>
<td>3.3</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>3.8</td>
</tr>
<tr>
<td>Reduced reaction cost</td>
<td>3.9</td>
</tr>
<tr>
<td>Single cell/molecule analysis</td>
<td>4.1</td>
</tr>
<tr>
<td>Portability/Small footprint</td>
<td>4.1</td>
</tr>
</tbody>
</table>

*Faster analysis time* is the most important
*Portability/Small footprint* is the least important
Impact: Value Creation

- Genomics: 33%
- Proteomics: 31%
- Point-of-Care Diagnostics: 63%
- Drug-discovery: 63%

Legend:
- No Impact
- Small
- Medium
- Large

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Diffusion & Adoption: Value Capture

- Genomics: 10%
- Proteomics: 52%
- Point-of-Care Diagnostics: 13%
- Drug-discovery: 65%

Legend:
- Don't Know
- Not at all
- Not very well
- Somewhat well
- Very well
Reason for Failure of Value Capture

Because microfluidics is an immature technology
Strategic Recommendations

1-3 Years
- Build collaboration with university laboratories
- Build features important to early adopters
- Develop whole-product solution for genomics and point-of-care diagnostics

3-10 Years
- Strengthen collaboration with university laboratories
- Focus on high-volume apps in genomics and point-of-care diagnostics
- Build features important to mass market
- Focus on drug discovery – seek alternate route for validation
QUESTIONS?