

MKW Ventures Consulting, LLC

Overview Q4, 2018

Mark Webb

Confidential: Not for distribution

Experience

- Mark K Webb is Principal of MKW Ventures Consulting LLC
- 23 Years at Intel Corporation and IM Flash Joint Venture with Micron
 - Fab Manufacturing, System Manufacturing, Device Engineering, Product Engineering, Q&R Engineering. Flash, Logic, Communication technologies
 - Most recent: Manufacturing Director for Intel NVM solutions Group, Product Engineering Manager for IM Flash JV reporting to Senior VP/Corporate Officer
- Left Intel in July 2012, Started consulting business
- Major Focus has been on SSD Business development for CM/ODM and Memory technology
 - SSD System Manufacturing, SSD Product roadmaps, SSD Market analysis.
 - NAND cost, New NVM cost and product roadmaps, storage industry
- Clients have been SSD OEMs/ODMs, NAND/memory OEMs, Storage/HDD companies, Industry Analysts
- Industry Contacts (monthly contact/exchanges) include
 - Senior Engineers and managers at multiple NAND manufacturers
 - Engineers and Managers at Logic manufacturers,
 - Leading memory/SSD/Semiconductor industry consultants and analysts
 - Engineers and directors at multiple ODMS/CMs/OSAT manufacturers.
- Mark's Experience and knowledge of Memory and SSD technologies is industry leading.

Q4 2018 Focus Areas

- SSD market analysis and development
 - SSD vs HDD markets, costs, strategies
 - Costs for 2.5”, M.2, and BGA SSDs on all interfaces
- NAND costs and technology. Industry recognized expert
- 3DXP and new NVM costs and revenue projections
- SSD interface roadmaps and form factors
- Logic (IDM and foundry) and Memory Fab wafer and unit costs
 - SOC costs, pricing, technology node roadmaps
 - Intel vs TSMC costs
- Presented multiple papers on NVM/NAND at annual FMS
 - Leading edge predictions on SSD, NVM, and NAND roadmaps each year

Q4 2018 Reports/Analysis

- SSD Market Analysis
 - SSD Revenue MSS for Client, Enterprise. Strengths, Weaknesses by company
 - NAND supplier vs HDD supplier business models
 - SSD density and unit shipments
- NAND Market
 - Current and modeled costs over time for industry and major suppliers
 - Wafer, assembly, test cost breakout
 - Quantitative Impact of different quality levels, screening, ECC/overprovisioning
 - NAND supplier models for dealing with customers, lead times, pricing
 - Fab start up costs, depreciation models, fixed and variable costs
- SSD Cost Analysis
 - Enterprise vs Corp Client vs performance consumer vs consumer
 - Real life examples from multiple OEMs
- New NVM Memories/Emerging Memory
 - Industry leading info on 3D Xpoint Optane, MRAM, ReRam
- China Memory plans and technology Status

Potential Opportunities

- **NAND cost modeling, Margins, DRAM exchange pricing vs actual unit cost.**
 - Prices vary widely for higher quality levels, although cost can be similar.
 - Predictions and implications of 3D NAND ramp
 - End Result: how much should we pay for NAND?
- **Supply agreement options with current and alternate companies**
 - End Result: How can we add or modify agreements to better support future options
- **SSD manufacturing costs and factory assessments.**
 - Benchmarking of factories for multiple NAND players and 5+ ODMs gives us unique perspective
 - Extensive knowledge of ODM costs and margin models for very inexpensive client SSD cards to very expensive enterprise solutions.
 - Test system benchmarking for quality and throughput
 - End Result: How do our factories compare to competitors
- **How can we add “ODM in” SSD designs to our portfolio?**

Follow Up

- Let us know how we can help your company
- Multiple business models available
- First meetings and discussions are free

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