

Project Management Challenges in the Microelectronics Industry

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Vice President, Technology Development
AMI Semiconductor***

June 20, 2007



Author Biography



- ***B.S. Chemical Engineering, Michigan State University 1980***
- ***EE Graduate Coursework, University Of Vermont 1981-1983***
- ***Masters Cert. Project Management, GWU 1999***
- ***Senior Member, IEEE***
- ***Member, AiChE***
- ***PMI Certified 1999, Albany, NY***
- ***Career Highlights***
 - Bipolar Technology Development, Memory Technology Development
 - 248nm Lithography Introduction, IBM
 - 4, 16, 64 & 256 Mbit DRAM Development
 - Project Manager, APM; IBM Essonnes France Plant
 - IBM 24 Years, AMIS 3 Years
- ***Current: Vice President, Technology Development, AMIS***
 - Silicon Process Technology
 - CAD Systems
 - Circuit Libraries
 - Pocatello Idaho / Oudenaarde Belgium

Outline



- ***Semiconductor Industry Overview***
- ***Semiconductor Technology Overview***
- ***AMIS – Who We Are & Why Do We Exist?***
 - In The Industry
 - In Southeast Idaho
- ***Project Management Challenges***
 - Standard Products
 - Custom Products
 - Technology Development
- ***Project Management Principles***
 - Unique Issues
 - Commonalities – The AMIS Pipeline
 - Quality, Reliability & Best Practices
 - Staying In The Race

Semiconductor Industry Overview



- **Apx \$260 Billion Industry Worldwide: North America, Europe, Asia**
 - Revenue Growing ~12%/Year
- **Electronic Functionality (density, speed) Growing 50%+/Year**
 - Relentless Productivity Learning Curve
 - Relentless Quality Improvement Curve
 - “Moore’s Law” – Scaling @ 2X/2Years
- **Examples Of “Exponential Improvement” In Microelectronics**
 - Disk Drives
 - Hard Disk, 1984, IBM \$300/Megabyte
 - 100GByte Hard Disk, 2007, Best Buy, \$0.00079/Megabyte
 - 400,000 less expensive per Megabyte Processors
 - IBM \$400,000 / MIP (Million Instructions Per Second) 1980 IBM S/370
 - Dual Core PC Processor, 2007, Intel QX6700 ~\$1000 = 57,000 MIPS at 3.33Ghz
 - 50,000X Improvement In Processor Speed
 - 22,000,000X Improvement In Processor Cost/Instruction
 - Memory
 - 64,000 Bit DRAM, 1984, \$1.00
 - 8,000,000,000 Bit Flash Drive, 2007 \$40
 - 3,000 times less expensive per bit of transistor circuitry
 - Space Program Apollo Command Module/Moon Lander 1968
 - 16 Kilobytes Of Memory On Board
 - Multi Billion Dollar Launch & Control Computer System
 - Far Less Compute Capability Than A Low End Video Gaming Device Today

Fundamental Component Density



1955

- 1 Component/Chip
- \$23.75 Per Component



Courtesy Of General Electric

2007

- 1 Gbit DRAM (or 16Gb NAND)
- ~\$7 (note \$2 for 512Mb!)
- 5,000,000,000 Components/Chip
- < \$0.000000003/Component



Courtesy Of Micron

8,000,000,000X Improvement In Cost Per Component

Semiconductor Technology Overview



● **Circuit Density – Minimum Printed Feature**

- R&D Minimum 22nm
- Production Minimum 45nm
- Production Range 45nm-4000 nm

● **Typical Materials Set**

- Silicon & P+/N- Dopants (As, P, B, etc)
- Aluminum, Copper, Tungsten, Titanium, Gold, Cobalt
- Silicon Oxide, Silicon Nitride, Some Exotics
- Polyimide, Thermoplastics, Thermosets

● **Lithography & Process Layers**

- Simple DRAM – 16 Layers
- Complex Logic – 25 Layers
- Highly Featured Mixed Signal – 40+ Layers

● **Design Process Per Chip**

- 1-12 Months Depending Upon Function and Complexity
- Teams Of ~4-100+ Designers

● **Cost Of Development**

- DRAM Generation ~\$100,000,000 (Technology, Design)
- Individual Custom Chip ~\$250,000 → >\$2,000,000

● **Volumes**

- Standard Memory: >10,000,000,000 units/year
- Custom Chips: As few as 10 (ex: Satellite or Space Project)

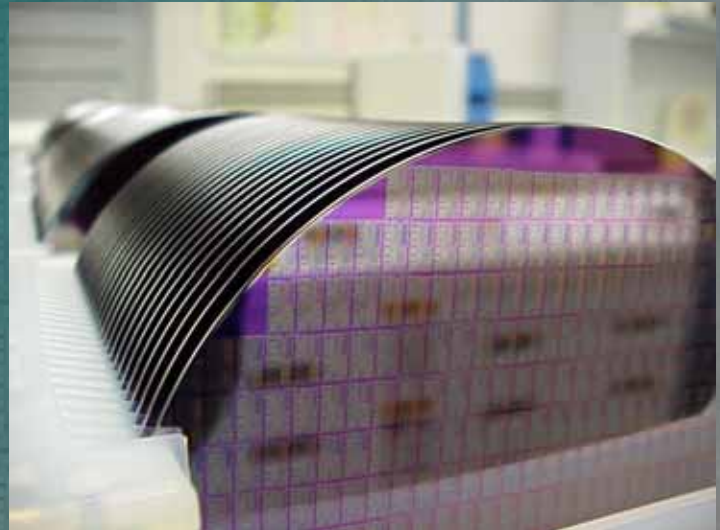
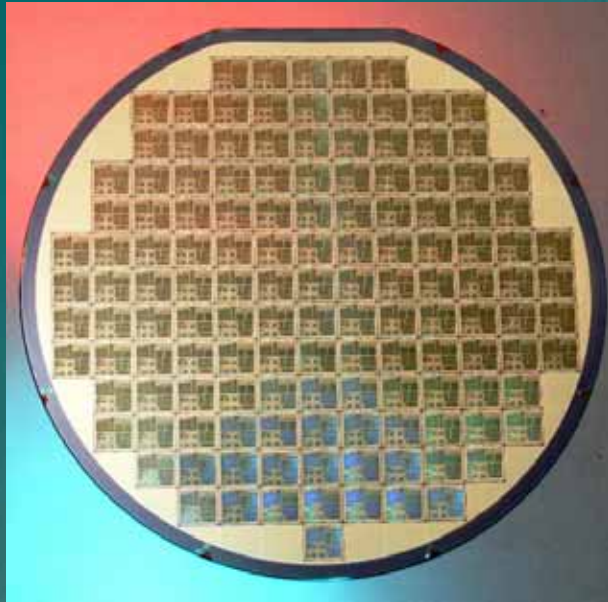
● **Plant Costs**

- Large Memory/Microprocessor Plant ~\$2,000,000,000 Investment
- AMIS-Type Custom Plant ~\$100,000,000 Investment

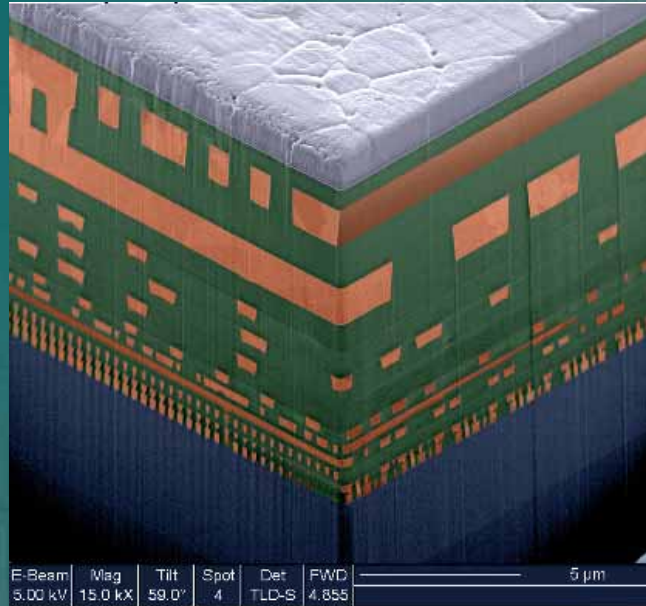
Semiconductor Process Cleanroom



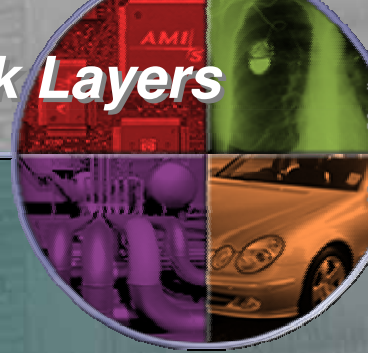
Silicon Wafer



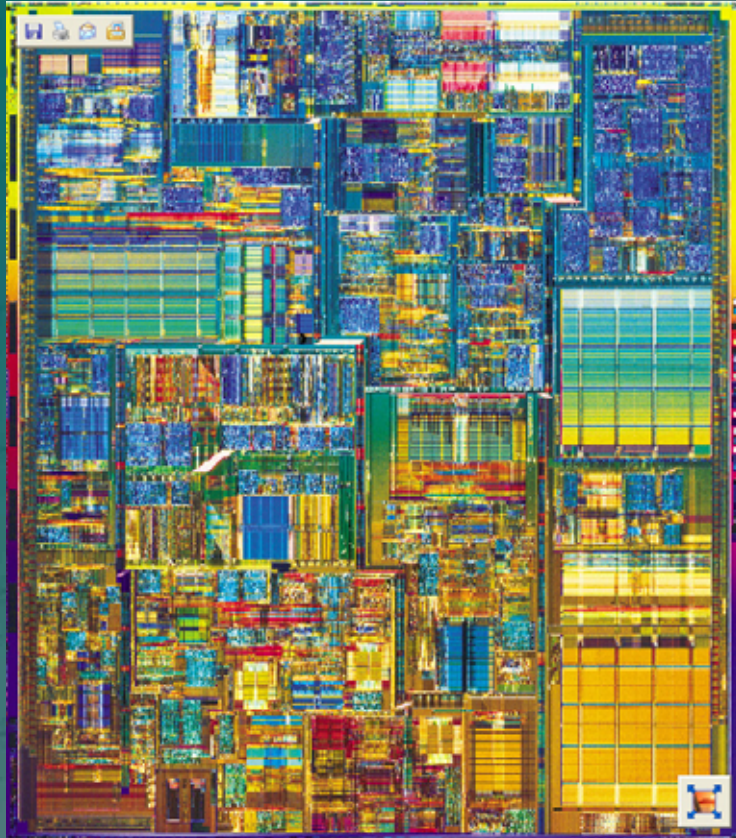
Multi Level Metallization—Up to 40 Mask Layers



Courtesy Of IBM

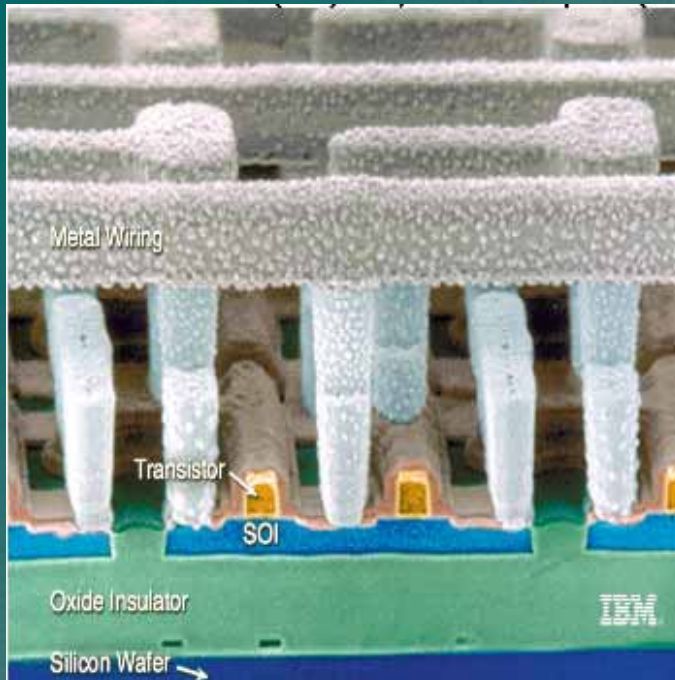


Millions Of Transistors On A Pentium Chip



Courtesy Of Intel

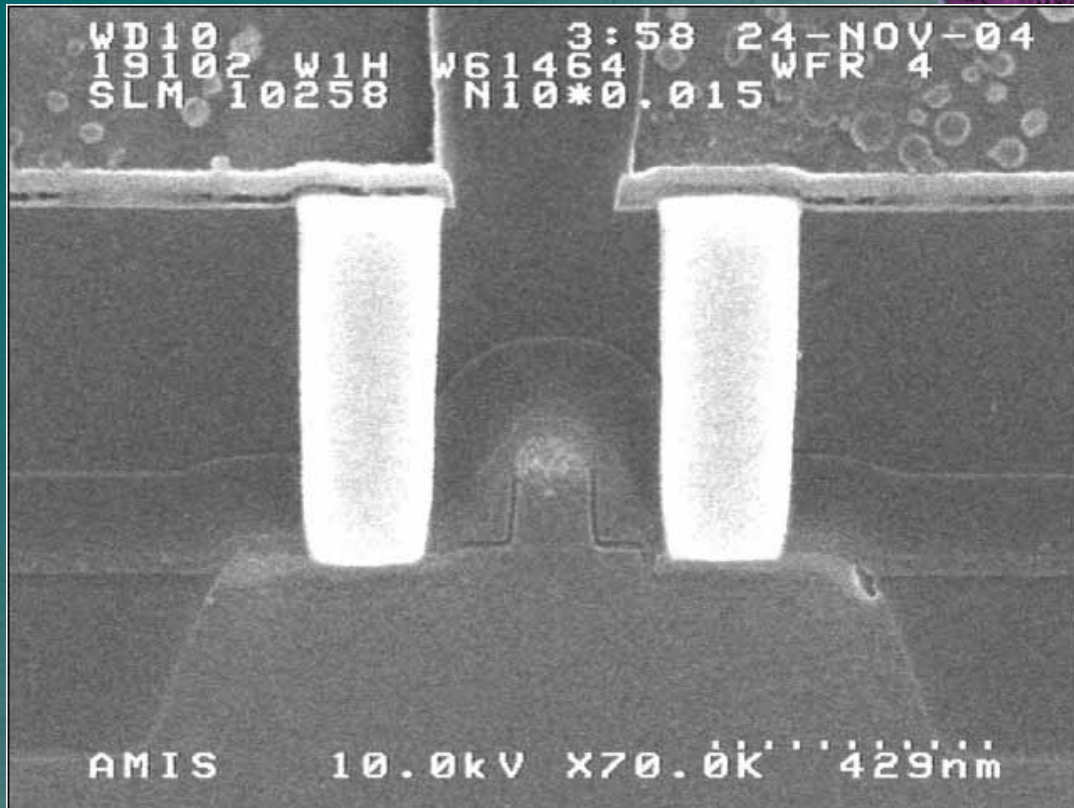
Integrated Materials



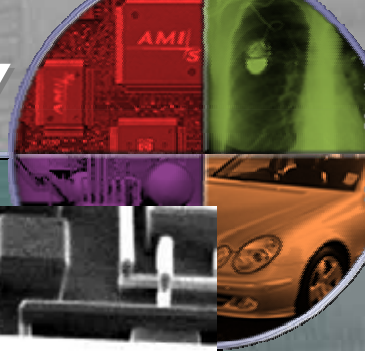
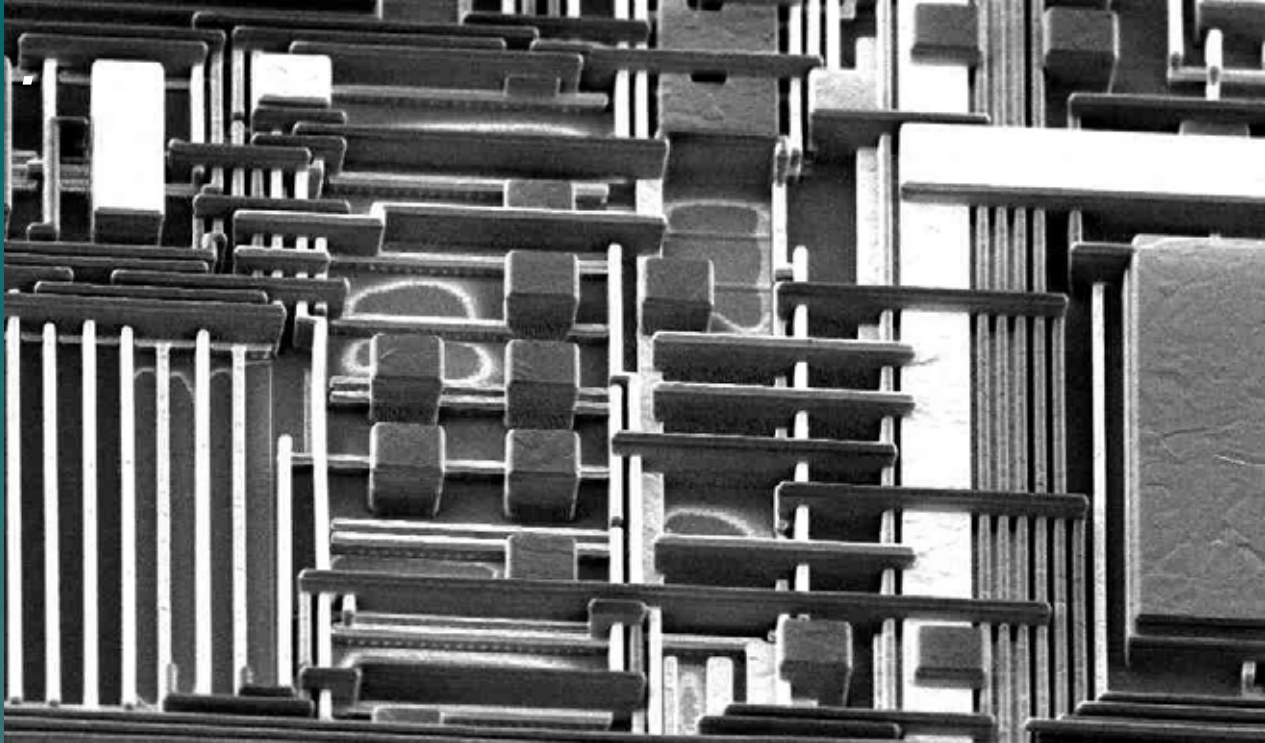
- **Silicon,
Oxide,
Tungsten,
Aluminum,
Copper....**

Courtesy Of IBM

Transistor Cross Section – Typical Chip



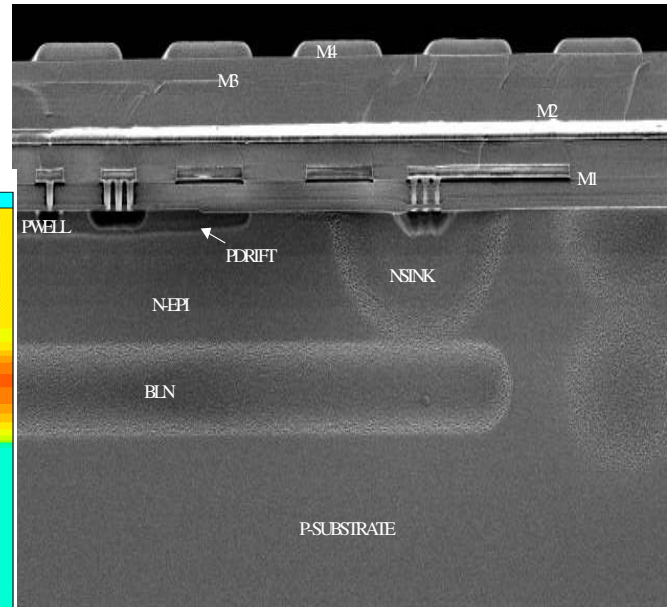
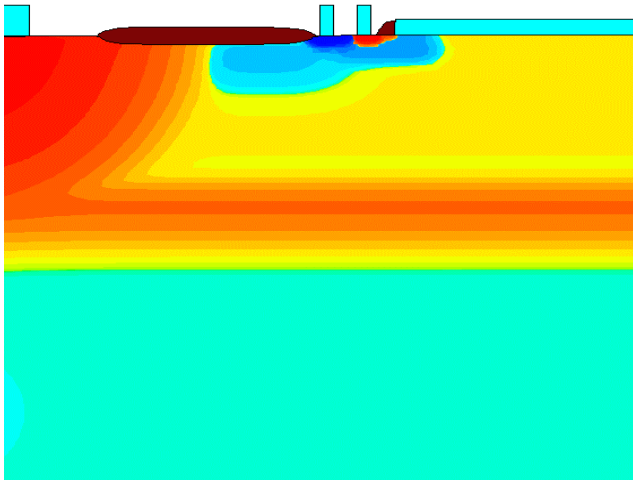
AMIS High Voltage Technology



AMIS High Voltage Device : TCAD to Silicon



... from TCAD to Silicon



AMIS:

Who We Are and Why We Exist



- **Nasdaq: AMIS**
- **Founded 1966 HQ: Pocatello, Idaho**
- **\$610,000,000/yr Semiconductor Manufacturer**
- **Serving The Automotive, Medical & Industrial Markets In Our Industry**
- **Specializing In “Real World” Sensor Interface Custom and Standard Products**
- **4 Wafer Fabs (Pocatello, ID & Oudenaarde, Belgium)**
- **Assembly In Manila, Philippines**
- **Many Worldwide Design Centers**
- **Growth Target 20%/Yr Revenue; 12%/Yr Operating Income**

AMIS Global Presence



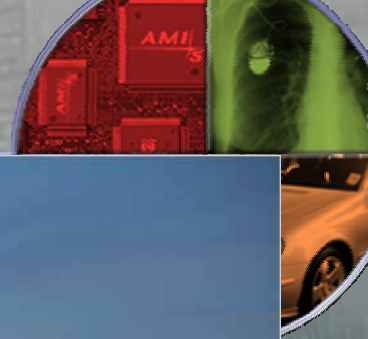
2,924
+915
22

Employees Worldwide
Engineers
Sales Offices Worldwide



*Manufacturing, Product Development, Sales/Design

AMIS – Pocatello Idaho



AMIS In SE Idaho



- ***Approximately 1,000 Employees***
- ***Major Net Exporter From Idaho***
 - Idaho High Tech Exports @ \$828,800,000 (1Q07)
 - 77% of Total Exports
 - IC's Account For ~80% of High Tech Exports
 - 62% of Total Exports
 - AMIS and Micron: Major Forces In SC Industry From Idaho
- ***Continuous Improvement In Job Content, Quality & Compensation***
- ***SE Idaho Payroll >\$80,000,000 In 2007***
- ***Pocatello's 3rd Largest Employer***
- ***ISU Research Partner***

AMI Semiconductor Mission

- ***To Enable Our Customers***  ***in Our Target Markets to Differentiate Their Products by:***
 - Proactively Developing Needed Technologies & Solutions
 - Acting as Extension of Our Customer's Development and Manufacturing Teams
 - Maintaining True "Partnership" Relationships at All Levels
 - Achieving Excellence in Execution
- ***85% of Our Products are Sole Sourced***
- ***Top 30 Customers Represent 61% of Revenue***

AMI Semiconductor Mission

**“The Solution Experts
Solving Demanding Problems”**

Mixed Signal 78% of 2006 Revenue
Digital 22% of 2006 Revenue



SENSING

CONTROL

DIGITAL

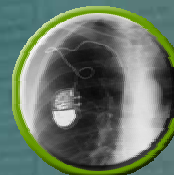
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**Application
Specific**



Automotive

2006: \$147M - 24%
Q406: \$40M - 25%



Medical

2006: \$99M - 16%
Q406: \$29M - 18%



Industrial

2006: \$162M - 27%
Q406: \$40M - 25%



Military/Aerospace

2006: \$45M - 7%
Q406: \$13M - 8%



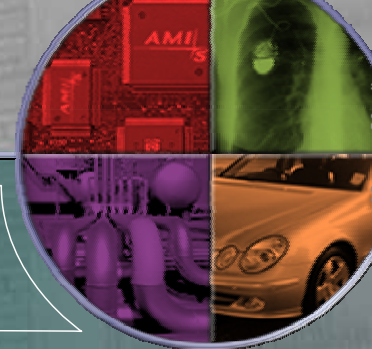
Communications & Computing

2006: \$126M - 21%
Q406: \$28M - 18%

AMIS Provides

- **Differentiated Products**
- **Customer Value Through Service**
- **Unique Technology**
- **Continuity of High Quality Supply**

AMIS Automotive Solutions



Overview and Market Position

- Ranked #4 worldwide with 9% market share⁽¹⁾
- Over 80% of revenue in Europe
- 24% of AMI's 2006 revenues
- 10% CAGR since 2003

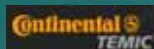
Customer Value

- **Proprietary High Voltage Processes**
- **Innovative Solutions:**
 - Sensor Interfaces
 - In-Vehicle Networking
 - High Voltage System-on-Chip
- **Non-Optional Applications**
 - Powertrain
 - Safety
- **Harsh Environment Applications**

Key Customers



BOSCH

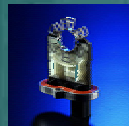


SIEMENS



Success Stories

Steering Angle Sensor

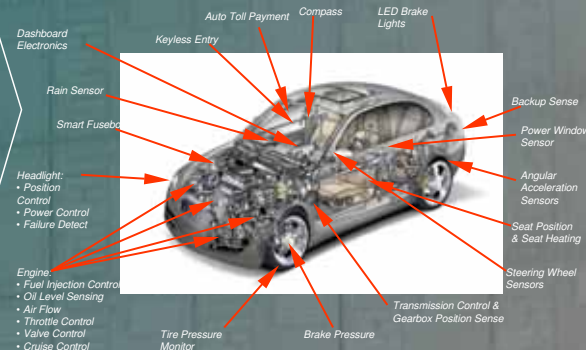


Angle Position Sensors for Headlight Control & Drive by Wire



Gyro Sensors for Roll Over Prevention

Typical Applications



(1) Based on Gartner data for 2005 Automotive ASIC market share

Source: Gartner, May 2006

AMIS Medical Solutions



Overview and Market Position

- Ranked #1 with 12% market share⁽¹⁾
- 73 customers including Top 4
- 16% of AMI's 2006 revenues
- 20% CAGR since 2003

Customer Value

- **Ultra Low Power Technology**
 - Digital Signal Processor
 - Memory
 - Specialized Analog Wireless
- **System Architecture & Solution Skills**
- **Flexible solution**
 - Custom and Standard Products
- **Evolving Software Suite**

Key Customers



GE Medical Systems



Medtronic
Where Life Expectations Meet Technology



ST. JUDE MEDICAL



Success Stories

Implantable Devices



Hearing Aids



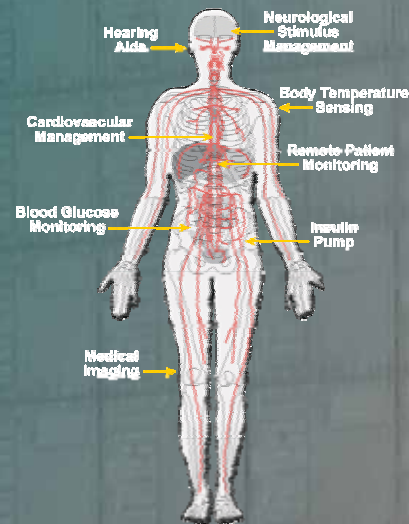
Medical Imaging



Personal Devices



Typical Applications



(1) Based on Gartner data for 2005 and AMI Semiconductor estimates

Source: Gartner, May 2006 and AMI Semiconductor estimates

Medical Electronics....Changing lives.....



...towards the “electronic pancreas....

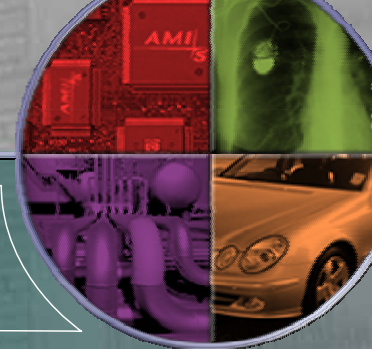
Medical Electronics

*Insulin
Delivery*

*Wireless
Glucose
Sensing*

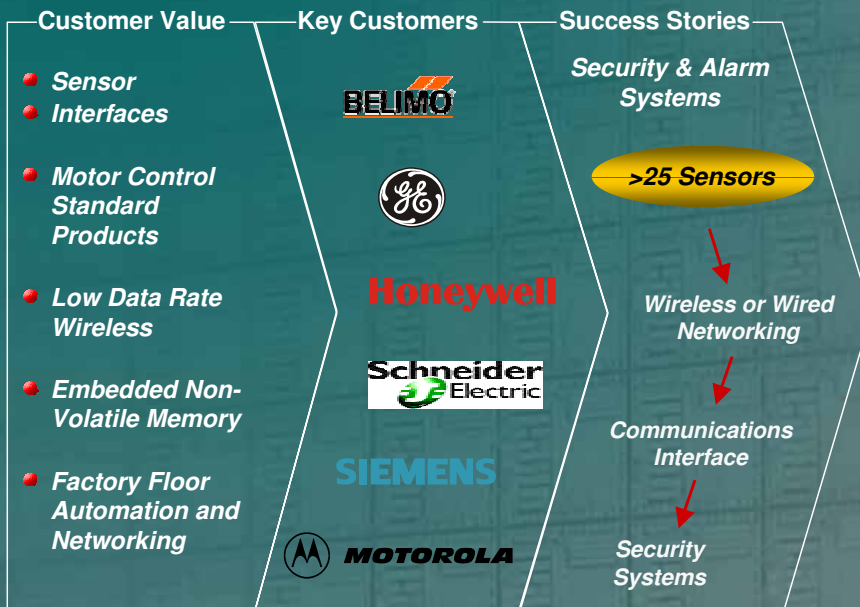


AMIS Industrial Solutions



Overview and Market Position

- Ranked #3 with 9% market share⁽¹⁾
- 49% growth in 2006
- 27% of AMI's 2006 revenues
- 21% CAGR since 2003



Typical Applications



Utility Metering

Sensor Interfaces & Valve Control



Barcode Scanners

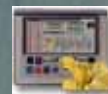
Appliance Control & Sensor Interfaces



Smart Motor Controllers



Circuit Breakers



Human-Machine Interfaces



Wireless Security & Alarm Systems

⁽¹⁾ Based on Gartner data for 2005
Source: Gartner, May 2006

A Leader in Military & Aerospace



Overview and Market Position

- Ranked #2 with 15% market share⁽¹⁾
- A majority of the key military and aerospace systems integrators (prime contractors) are AMI customers
- 7% of AMI's 2006 revenues
- 11% CAGR since 2003

Customer Value

- *Imaging Technology*
- *FPGA Conversions*
- *Military Specification Quality*
- *Domestic & Long Life Supply*

Key Customers



Honeywell



Raytheon

Rockwell Collins

Success Stories

FLIR Night Vision Provider



Thermal Imaging



Typical Applications

Military Radios/Battlefield Communications



Guidance & Target Acquisition



Optical & Infrared Detectors



Missile Systems

(1) Based on Gartner data for 2005 Military / Aerospace ASIC market share
Source: Gartner, May 2006

Project Management Challenges

- **Megaprojects!**

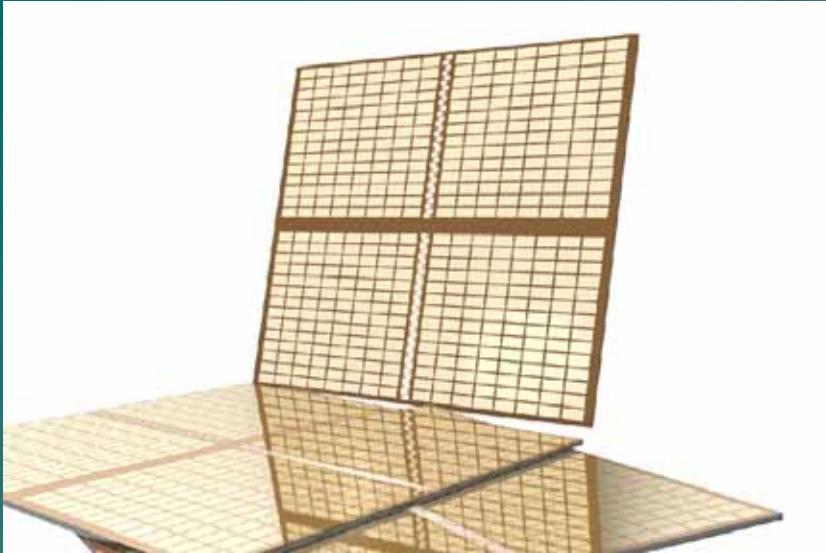


\$1,000,000,000 Per Unit
15,000 Tons
Complexity: Extreme!



Project Management Challenges

● *Nanoprojects!*



\$2 Per Unit

>\$1,000,000,000 per factory

<1 Gram

> 64,000 Pages Of Data/cm²

Complexity: Extreme!

Courtesy Of Micron



Project Management Challenges



● ***Standard Semiconductor Products***

- Manage Development Within Industry Defined Constraints
- Market Availability
- Competition
- Unit Cost Competitiveness
- Industry Standard Specifications (ie DRAM Memory Chip)
- Spans of 12-24 months

Project Management Challenges



- ***Custom Semiconductor Products***
 - Contractual Obligations
 - Changes of Scope
 - Relatively Short Development Spans
 - Risk of Loss of Customer's Market Window
 - Varying Quality Standards
 - Communication Management
 - Spans of 6-18 months

Project Management Challenges



● ***Silicon Technology Development***

- Design For Reuse – Scope Beyond Specification
- Quality Control
- Conflicting Priorities / Demand For Same Resources
- Often Critical Path To Custom Product Development
- Spans of 6-36 months

PM Principles – Unique Issues

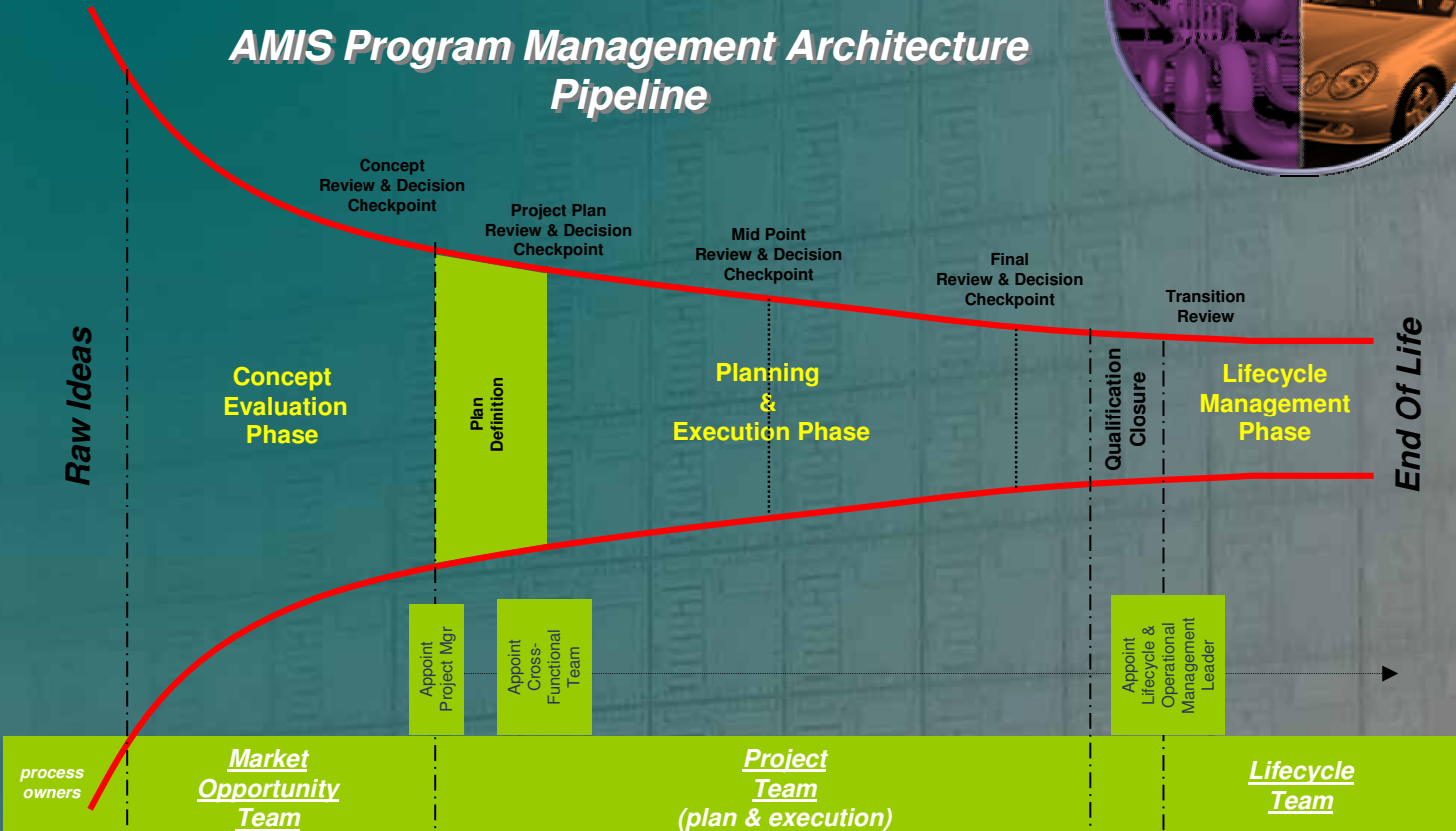


- ***Very Dynamic Industry***
 - “You snooze, you lose”
- ***Project Teams Geographically Dispersed***
 - Language and Cultural Barriers
 - AMIS: 4 Working Languages / 3,000 Employees
 - Non-Overlapping Work Time – Challenging Collaboration
- ***Project Spans Limit Level Of Detail Of Project Plan***
 - Rigor and Granularity

PM Principles – Commonalities



AMIS Program Management Architecture Pipeline



Project Risk Management



● **Quality Risk**

- Parts Per Million Quality – 10+ Year Lifetimes
- Life Critical Applications
- System Redundant Applications
- Cost / Function / Quality “Triple Constraints”
 - QUALITY=LIFE

● **Delivery Risk**

- Design Cycle Times
- Manufacturing Yield and Cycle Times
- Extremely High Value Product
- “Cost Shelf Life” Due To Moore’s Law

Project Scope Management



● ***Design Specification Changes***

- Market Driven
- Customer Driven
- Standards Driven

● ***Environmental “Scope Creep”***

- Ultra-High Speed (Computing)
- Ultra-Low Power (Implantable Medical)
- High Temperature (Automotive)
- High Noise, Electrostatics etc (Military, Industrial)
- Harsh Environment (Vibration, Heat, Cold)

“A Harsh Environment” ... A Typical Example



● *High Energy Circuit Breakers*

- Standard Industrial Application
- Quiet, Stable “Power Box” Room Applications
- Temperature/Humidity Controlled....

● *...Then NASA Calls...Scope Change.....*

- “Special Application”
- Must Make It Reliable Under “this special condition...”
-Because Lives Depend On It!



(film)

(courtesy of NASA)

(where all the really cool people work)

Staying In The Race....PM & Microelectronics



- ***Alignment of Strategy, Projects and Resources***
- ***Customer Responsiveness***
- ***Relentless Pursuit of New Markets***
- ***Solid & Stable Technology Platform***
- ***Highly Managed Cost Structure → Everywhere in the Business***
- ***Active Participation in Industry Standards Organizations***
- ***Ability To Translate Opportunities and Scope Changes Into Value & Predictable Cost → Gross Margin & Profit***
- ***SOUND Project Management Principles***
- ***Flexibility – to the Extreme***



Thank You!