Fiber-Optic Components – Is This Any Way to Earn a Living?

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Peter Bordui, Chairman, Bookham
Outline

• Bookham overview
• Technology bubbles
• Fibre-optic components value chain
• Options for a business
• Vertical integration for worse and for better

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Bookham History

1988
Entrepreneurial Start-Up
- Silicon optical circuits

2000
Initial and Follow-On Public Offerings
- $10B market cap in 2000

2002
Post –Bubble Acquisitions:
- Marconi
- IQE
- Cierra Photonics
- Nortel
- ONETTA
- New Focus

2004
Consolidation & Restructuring
- Headquarters moved, UK to US
- III-V wafer fab moved from Canada to England
- Assembly & test operations moved from England to China
- 5 sites closed
- >1500 jobs transferred

2006

2008
**Bookham Today**

- **Caswell (UK)** - 130 staff
  - InP Wafer Fab
- **Paignton (UK)** - 120 staff
  - Telco Product Dev
- **Zurich (Switzerland)** - 170 staff
  - GaAs Wafer Fab
  - HPL & VCSEL Product Dev
- **Santa Rosa (CA)** - 70 staff
  - Thin-Film Filters
- **San Jose (CA)** - 170 staff
  - Corporate HQ
  - Photonic Tools
- **Shenzhen (China)** - 1400 staff
  - Assembly & Test
Cumulative Deficit, 2000 through 2007

$Millions

-200
0
200
400
600
800
1000
1200

Dec-99  Jun-00  Dec-00  Jun-01  Dec-01  Jun-02  Dec-02  Jun-03  Dec-03  Jun-04  Dec-04  Jun-05  Dec-05  Jun-06  Dec-06  Jun-07  Dec-07
Technology Bubbles

World-changing invention → Building & investment → Overbuilding & overinvestment → Crash

Historical recoveries on order of decades, not years
Fibre-Optic Telco Bubble

• Analogous origins to previous technology bubbles, nothing fundamentally new

• Recovery still playing out:
  • Last 10 years of financial performance not a good guide to future expectations
  • Many companies still working through structural and operational inefficiencies associated with overbuilding
  • Market itself still with an overabundance of suppliers

• Bubble effects will continue to decrease
Figure 6.14: Components for Telecom and Datacom: Revenue and Forecast, 2000-2017

Sources: OIDA member companies, KMI, Ovum-RHK, Laser Focus World, LightCounting, iSuppli, TIA, IDC, CIR, Gartner, Dell’Oro, PIDA, OITDA, OIDA estimates

Squeezed between Customers & Suppliers

Customer-side pressures:
• Carriers coping with view that “Internet should be free”
• Components a large fraction of equipment makers’ costs
• Consolidation among carriers and equipment-makers

Price erosion, lead-time reduction, vendor-base streamlining

Supplier-side resistance:
• Suppliers with large and diversified revenues – Fibre-optics not critical
• Few suppliers for certain in-feeds
• Credit-rating weakness

Can’t push problems “upstream”
Pricing Pressures

Price Trend in percentage of 4Q05 Baseline

Source of Laser and Transponder data: Dell-Oro

Segment Price Reduction (in 12 quarters)

- WB Transponder: 42%
- Tunable Laser: 32%
- In-Feed “A”: 26%
- In-Feed “B”: 20%
Fiber-Optic Components Market Share by Supplier

Source: RHK-Ovum, Dec-07
### Multiplicity of Business Models

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- The table indicates various business models across different components (Subsystem, Module, Package, Chip) and design/assembly processes (Ass’y, Design, Fab).
Differences between Business Models

Current fibre-optic component business models:

• Different cost structures
• Different supplier bases
• Different customer bases
• Different competencies
• Different approaches to value creation and differentiation
• Different risks of substitutes
• Different risks of new entrants

→ Limited comparability between companies pursuing different models

→ Broad range of relative strengths and weaknesses
Example: Vertical Integration

One big negative, numerous positives:

• Large fixed cost base

• High variable margin
Chip-Fab Economics

Fixed overhead versus variable margin benefit (10-20%)
Example: Vertical Integration

One big negative, numerous positives:

- Large fixed cost base
- High variable margin
- Hands-on control over quality, safety, and social-compliance aspects of products
- Resistant to IP abuses and counterfeiting
- Flexible in responding to lead-time challenges
- Access to markets at component, module, and subsystems levels, important in informing R&D efforts and amortizing R&D costs
- Access to innovation at chip level, key to improvements in product performance and cost reduction
Tunable Transmitter Assembly (TTA): Hybrid integration of InP tunable laser and MZ modulator chips
Chip Innovation – Continuous Improvement

- Tailored grating for “featureless” digital tuning maps

- On-wafer testing for improved process control

- Regular endurance testing (Production wafers with <5GHz stability over 30k hours)

- Ongoing development for
  - Increased power (100 mW ex-facet)
  - Increased (60 nm) tuning range

Fig. 2 Tuned ex-facet power across full tuning range for 380 mA SOA current
Chip Innovation – Next-Gen Products

40G and 100G Transmission:

Full-band tunable DQPSK Encoder is compatible with today’s 10G footprint
Integration of DSDBR laser and MZ modulator on same chip

- 3” diameter wafer process, common with discrete DSDBR and MZ devices
- Integral monitor detectors and bias control
- Cost reduction through
  - reduced handling
  - fewer packaging components
  - smaller footprint
- Compatible with parallel modulator integration for higher speed and phase coding
A Foundry-Model?

Could a centralized III-V chip foundry adequately support necessary innovation in device performance and cost reduction?

Current reality:
• Leading-edge chip design linked to fabrication process capability
• Fab process capability a major source of competitive differentiation

Foundry-model not able to support critical innovations in product performance and cost
Example: Vertical Integration

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• Access to innovation at chip level, key to improvements in product performance and cost reduction

• Opportunities to leverage capabilities in new markets
Leveraging into New Markets

• Technical capabilities

Laser Products for Materials Processing:
- SM Cooled Module Seed Laser
- 10W 9xx nm MM Uncooled Module
- 80W 9xx nm Multimode Bar on Microchannel Cooler

Filter Products for Bio Instrumentation:
- LED Multiplexer for Fluorescence Illumination
- Precision Filters for PCR Fluorescence and Cytometry

• Business-process capabilities
Summary Observations

• Bubble recovery still playing out
• Fundamental demand for fiber-optic components, although components suppliers currently at weak point in value chain
• Large number of suppliers, with broad range of business models in play
• Chip innovation drives industry-wide performance and cost improvements; Not easily outsourced
• For integrated suppliers, potential for leveraging into new markets