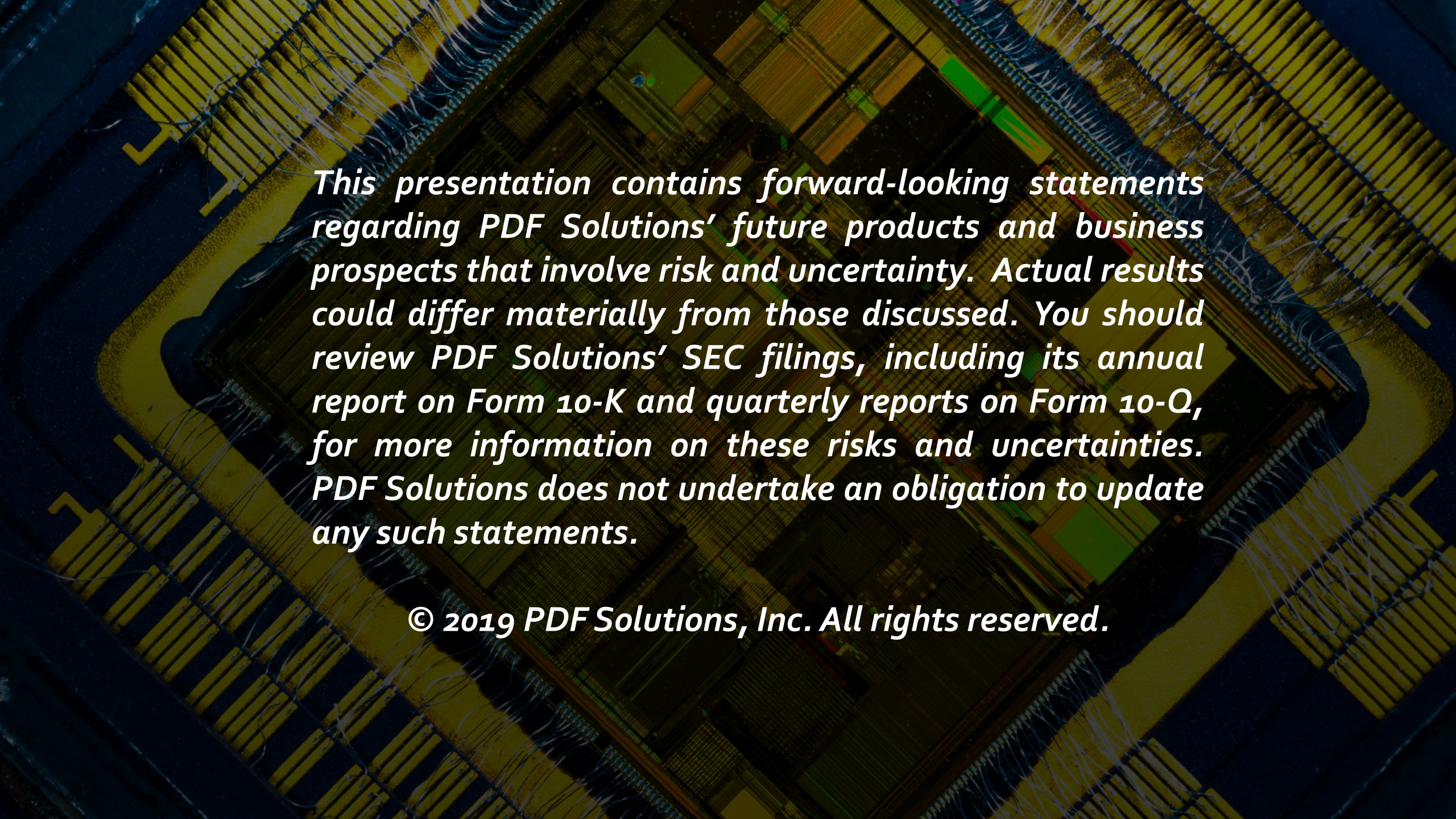
2019 PDF Solutions
Analyst Day

PDF/SOLUTIONS™

S1.5A – PDF Overview

October 15, 2019

Kimon Michaels, EVP, Director, & co-founder

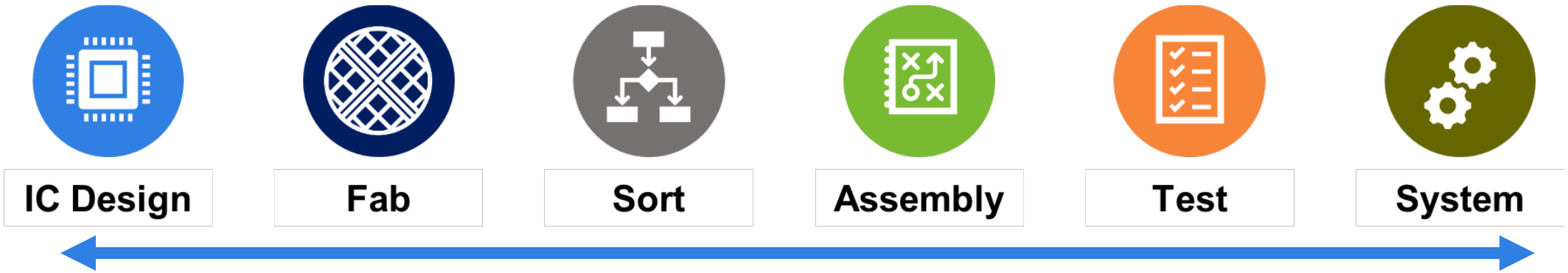


This presentation contains forward-looking statements regarding PDF Solutions' future products and business prospects that involve risk and uncertainty. Actual results could differ materially from those discussed. You should review PDF Solutions' SEC filings, including its annual report on Form 10-K and quarterly reports on Form 10-Q, for more information on these risks and uncertainties. PDF Solutions does not undertake an obligation to update any such statements.

PDF Solutions

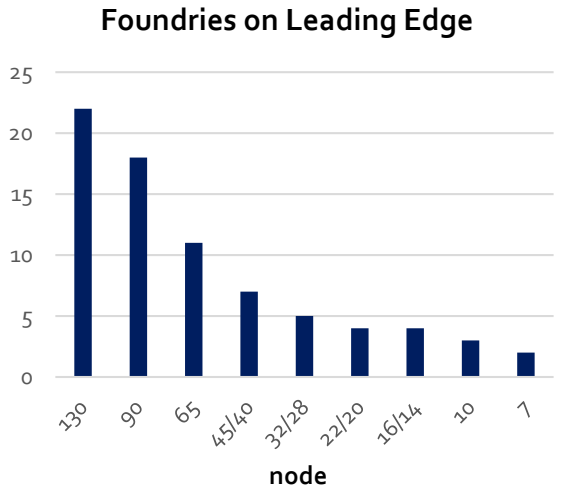
- **PDF is an analytics company that improves process efficiency and product reliability for the semiconductor supply chain**

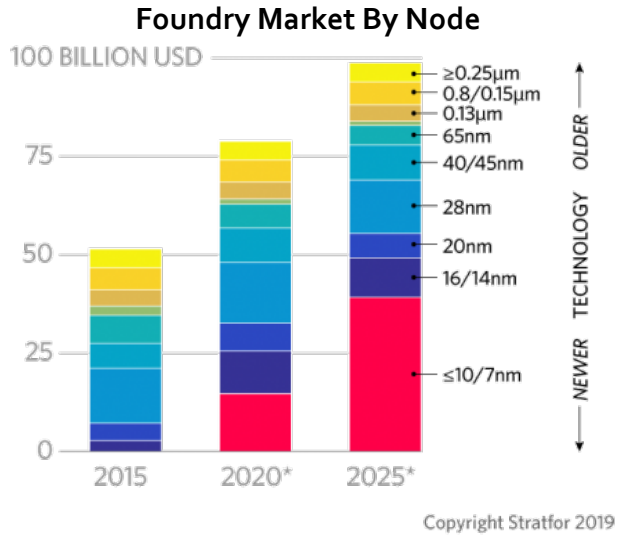
- **PDF uniquely provides:**
  - An end-to-end big data analytics solution designed to meet the needs of the semiconductor value chain
  - Differentiated data obtained during manufacturing, test, and in-field use from IP integrated into semiconductor devices



Value Shifting to Mass Production

www.techrepublic.com/article/moores-law-is-dead-three-predictions-about-the-computers-of-tomorrow





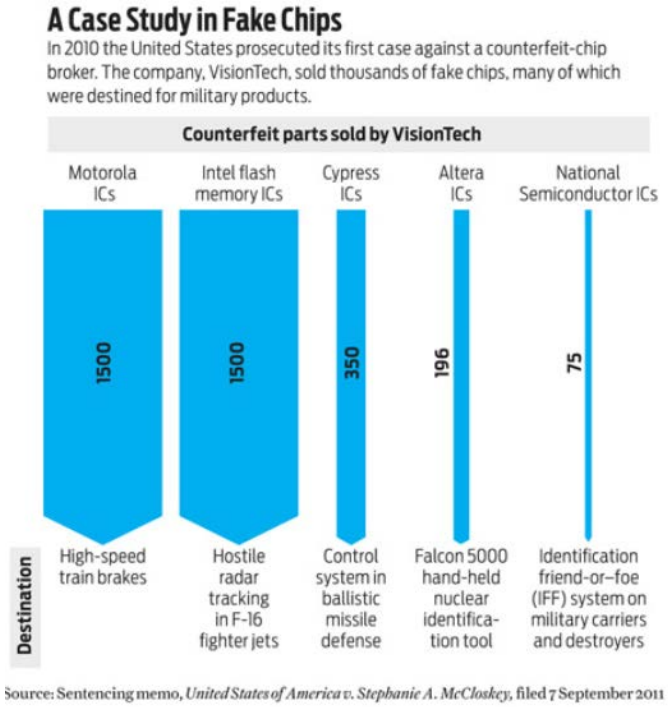
- Trends:
  - Moore's Law is slowing down, and foundry business is consolidating due to process complexity
  - Percentage of foundry market in finFET nodes expected to continue to grow
- Implications:
  - Increased value in mass production continuous improvement vs. time to market
  - Financial risk shifting away from foundry to fabless & system companies

OSAT Role in Supply Chain Increasing

Move to chiplets …

www.anandtech.com/show/14211/intels-interconnected-future-chipslets-emib-foveros

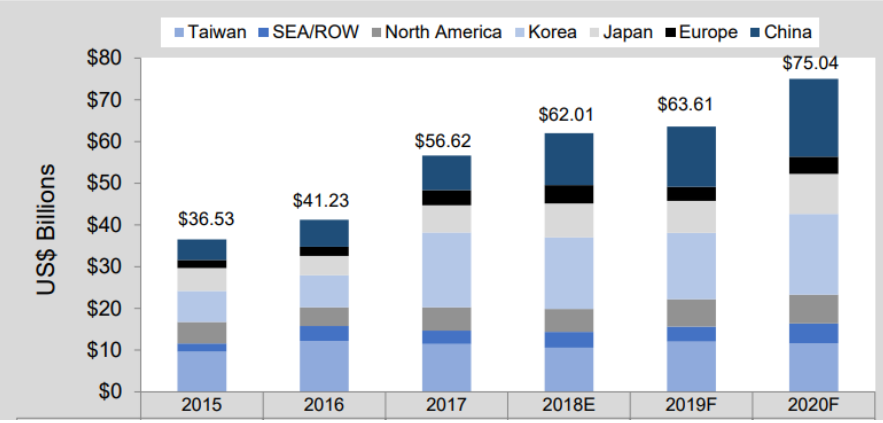
Increases risk of security and counterfeits



- Increase in analytics need at OSATs due to growth in system-in-package (SiP) and chiplet usage
- Growing need for
  - Process control
  - Traceablilty for security, quality and reliability monitoring / diagnosis
  - Known-good die metrics to ensure final SiP achieves specifications

Market Growth is with Fabless/System, Asia

Semi equipment by market region



SEMI Europa Nov 2018

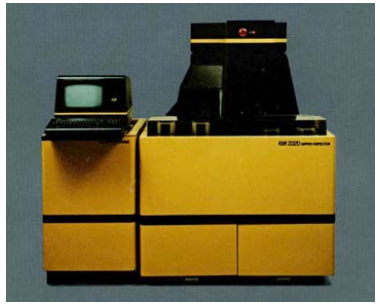
Reliability: growing fabless/system issue

www.infineon.com/dgdl/Living+Automotive+Excellence.pdf?folderId=db3a30431ce5fb52011d2dd52b231e7d&fileId=db3a30431ce5fb52011d2dd5ca751e7e

- Foundry growth and capex spend continues its shift to Asia, particularly China
- More responsibility for good die lies with fabless / system companies
  - Increase in failures due to power / performance / reliability
  - Consolidation in foundry market leads to little differentiation in process capability

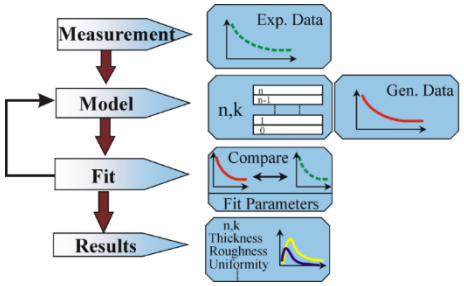
Value Shift to Analytics

KLA 2020 (1984)



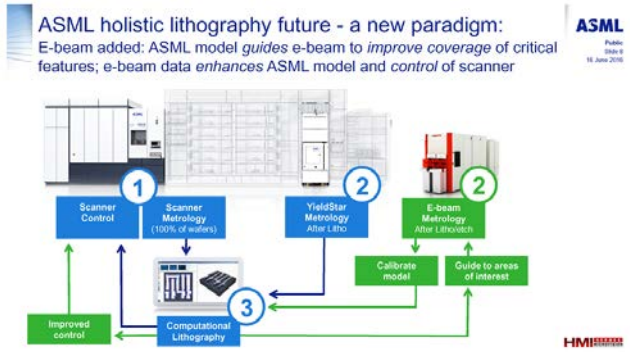
siliconvalleyhistorical.org

Software-aided metrology

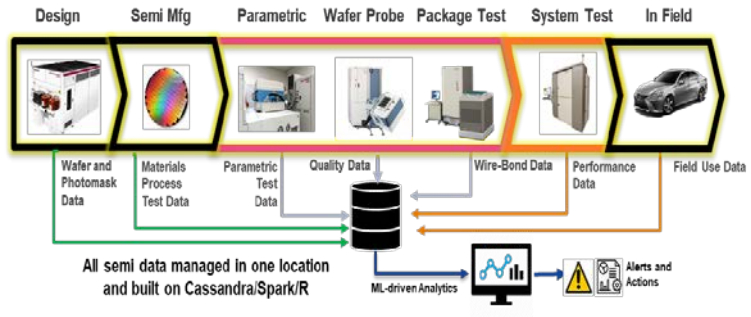


www.jawoollam.com/resources/ellipsometry-tutorial

In fab analytics



Cross-supply chain analytics

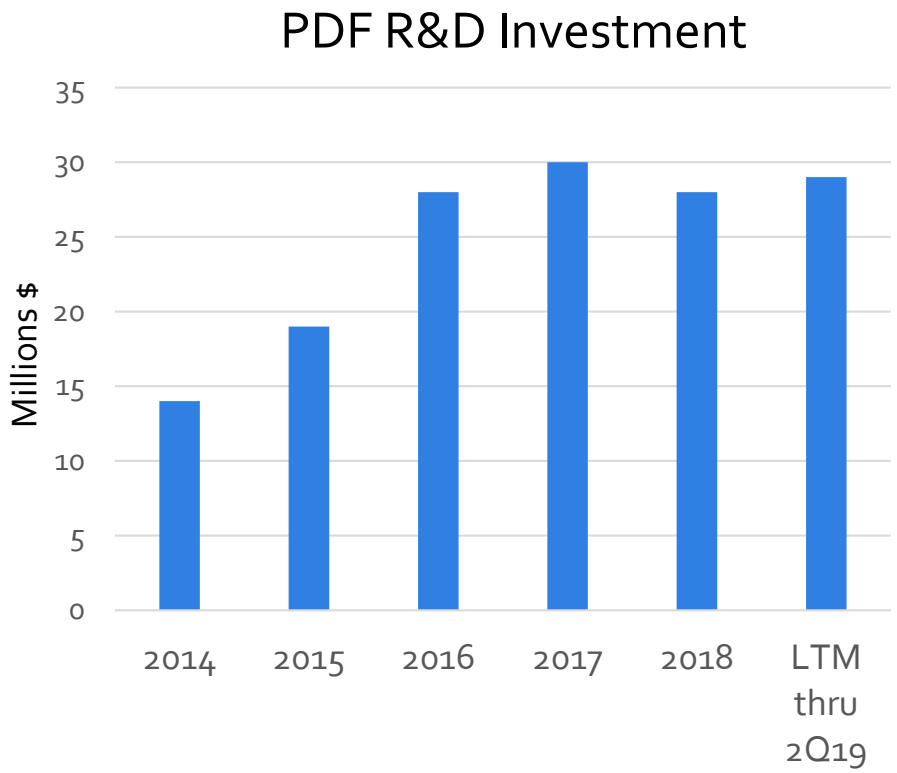


Time

Complexity of scaling has driven increased need and value in analytics

- ***Yesterday:***
  - Hardware first directly measured structures
  - Software then needed to interpret direct measurements
- ***Today:*** Process control analytics in fab combining multiple data sources
- ***Next:*** Cross-supply chain analytics incorporating data from multiple suppliers

PDF Has Invested Ahead to Serve The Industry



Since 2015

4 acquisitions

$43.6M capex investment

- Since 2015 PDF has increased investment to be well positioned for the Post-Moore's Law era
- Investment & acquisitions in analytics to span the supply chain with advanced capability
- Investment in differentiated electrical data important to our customers
  - To achieve yield, quality, reliability requirements

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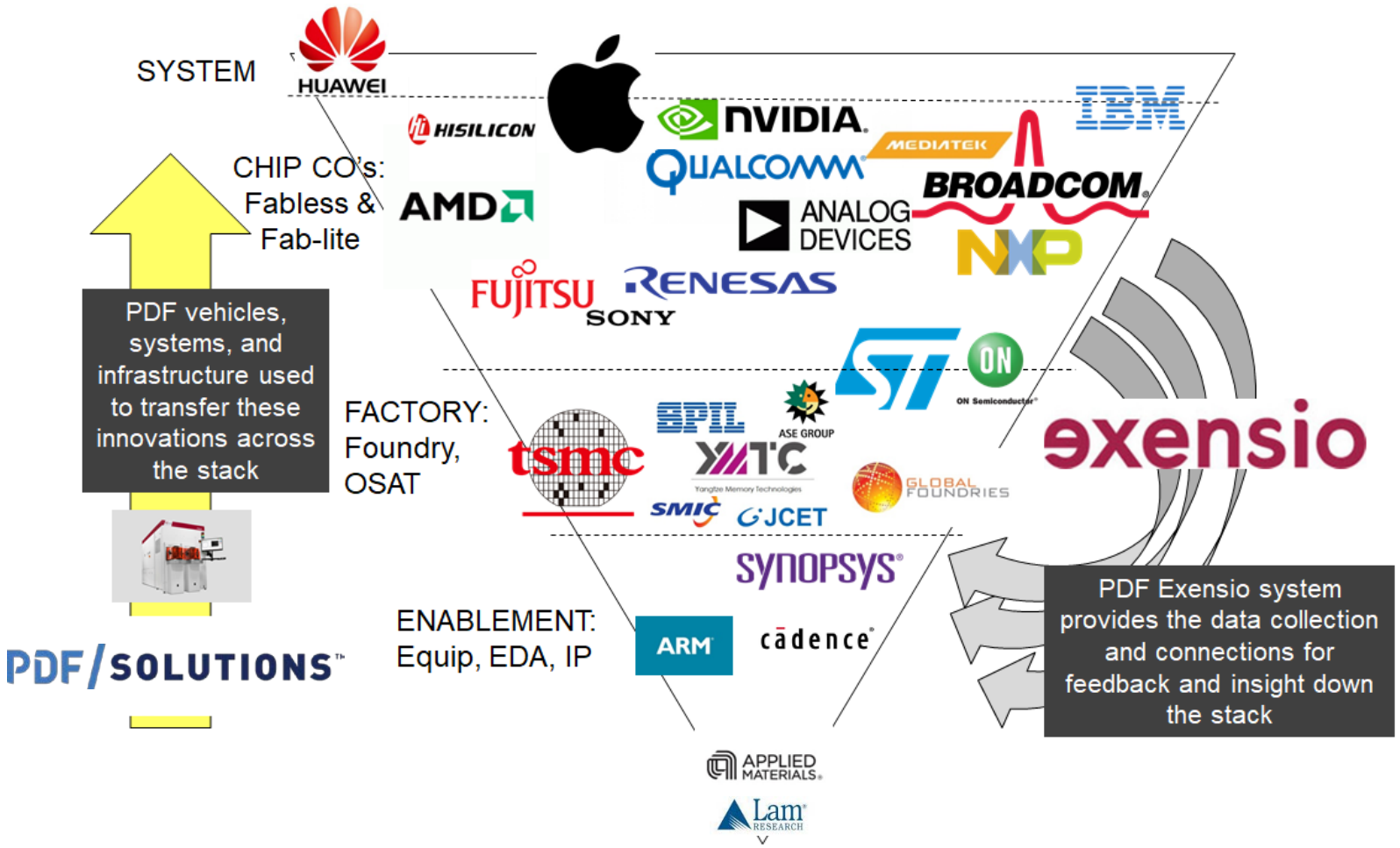
Today PDF Bridges the Supply Chain Stack

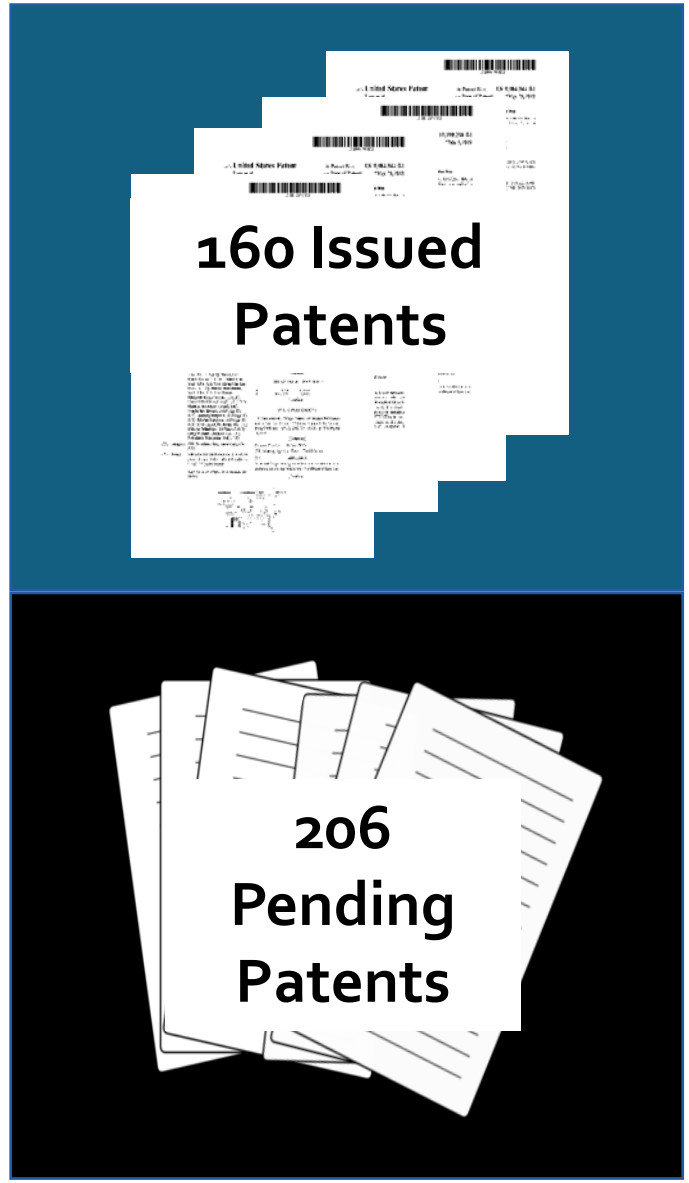


Representative industry participants; not indicative of actual customers.
Logos are the property of the respective trademark owners.

- PDF analytics and data implemented broadly across the supply chain
- PDF continues to increase our established relationships with critical industry members
- PDF is the only commercial analytics-focused provider with breadth and scale required by our customers

Investment Results in Strong Patent Position

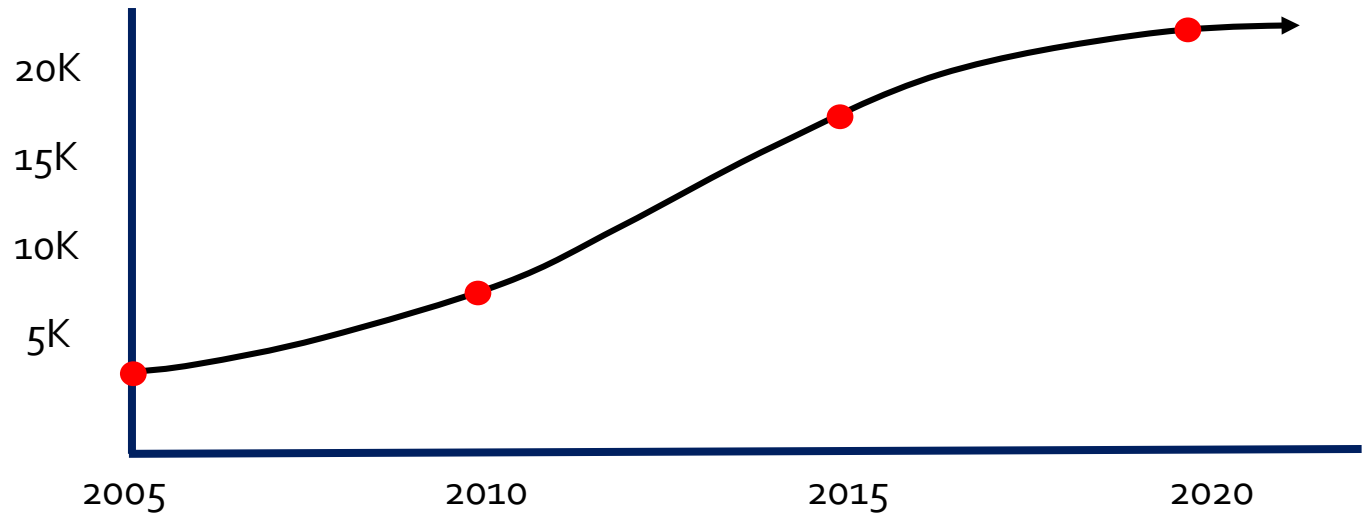
- Our investments in analytics & differentiated data result in a strong and growing patent position
- Patents based on 28 years of know-how in semiconductor development and mass production
- Key patents in areas of:
  - Design for inspection and CV structures for advanced nodes
  - Electrical characterization
  - AI/ML technology



Broadest Integration With Leading Manufacturing Tools

>24K process tools under PDF process control across the ecosystem

#1 commercial, comprehensive solution for manufacturing yield and control

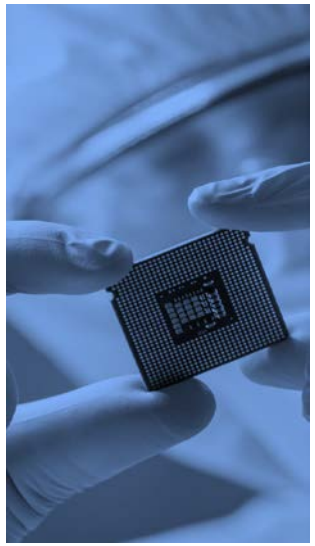


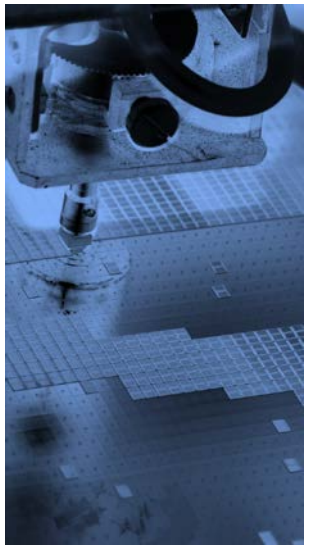
Process tools are continually added to this list based on customer demand

Logos are the property of the respective trademark owners.

Leading Commercial Solution for Single Die Traceability

Leading commercial solution for semiconductor die traceability through the supply chain





Assembly and Packaging Equipment

Wire Bonding
Die Attach
Die Feeder
Singulation
Stud Bumper
Laser Mark
Strip Test
Inspection
Auto Wire Checker

~50 vendors
>150 equipment models

Assembly/packaging tools are continually added to this list based on customer demand

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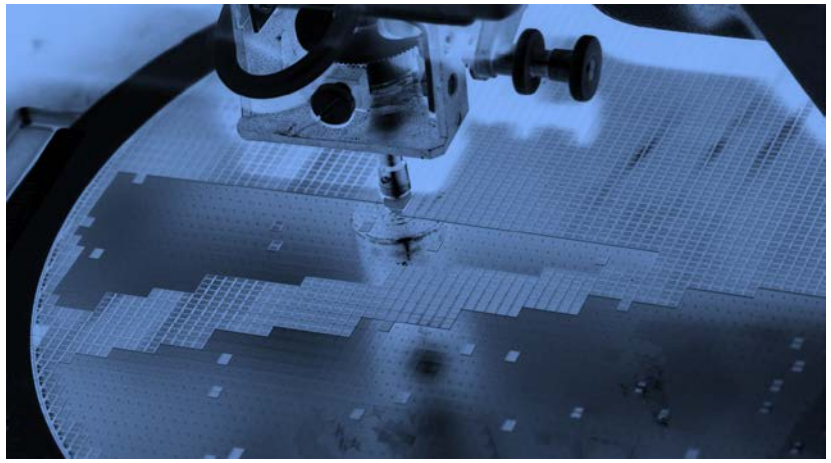
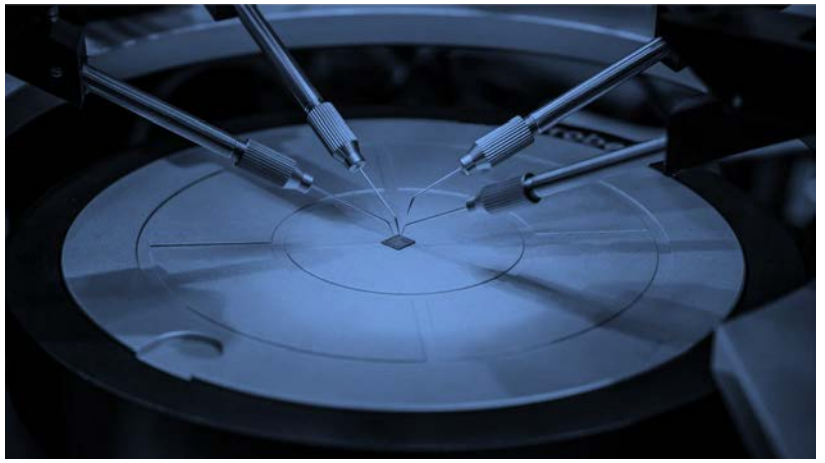
Robust Support for Manufacturing Test Operations Equipment

Support for all major tester, prober and handler vendors



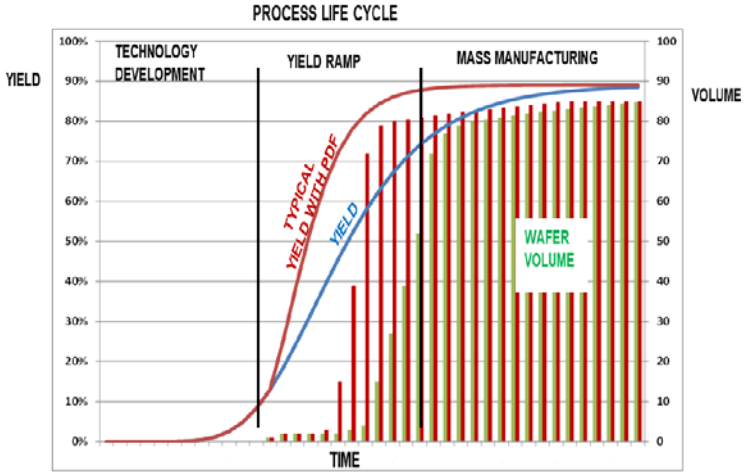


Test operations vendors/tools are continually added to this list based on customer demand

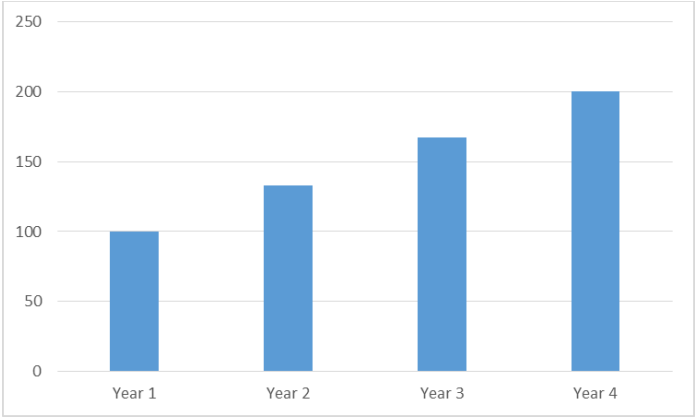
PDF Business Models

- PDF has always provided solutions combining advanced analytics and differentiated data
- PDF has two business models to capture the value of our solutions
- Gainshare model: when value is time to volume
  - In competitive foundry market, time to mass production is critical.
  - The variable fee royalty model enables PDF to be compensated based on measurable value delivered
- Subscription model: when value is data
  - During mass production, use of our solutions by customer engineers enables continuous improvement and monitoring of yield and reliability
  - Subscription model enables PDF to be compensated based on usage

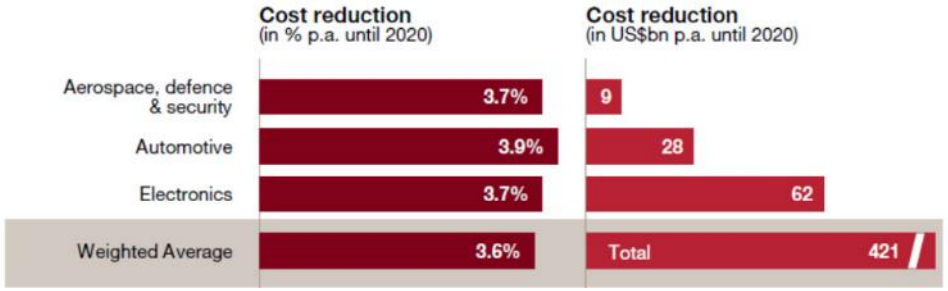
Gainshare model value



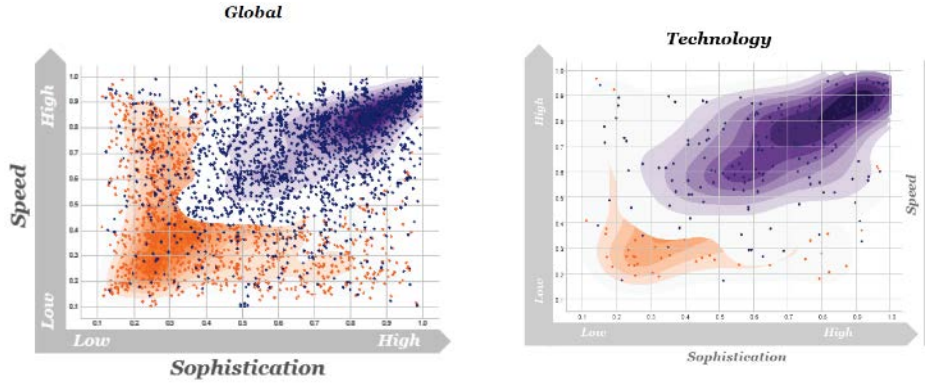
Subscriptions grow ARR over time



Data and Analytics Growing in Importance



High-tech sectors will see a greater percentage of cost reductions than average and represent nearly a fourth of the total revenue reductions tracked.



Companies moving to faster decision speed with greater sophistication, especially in tech. sector.

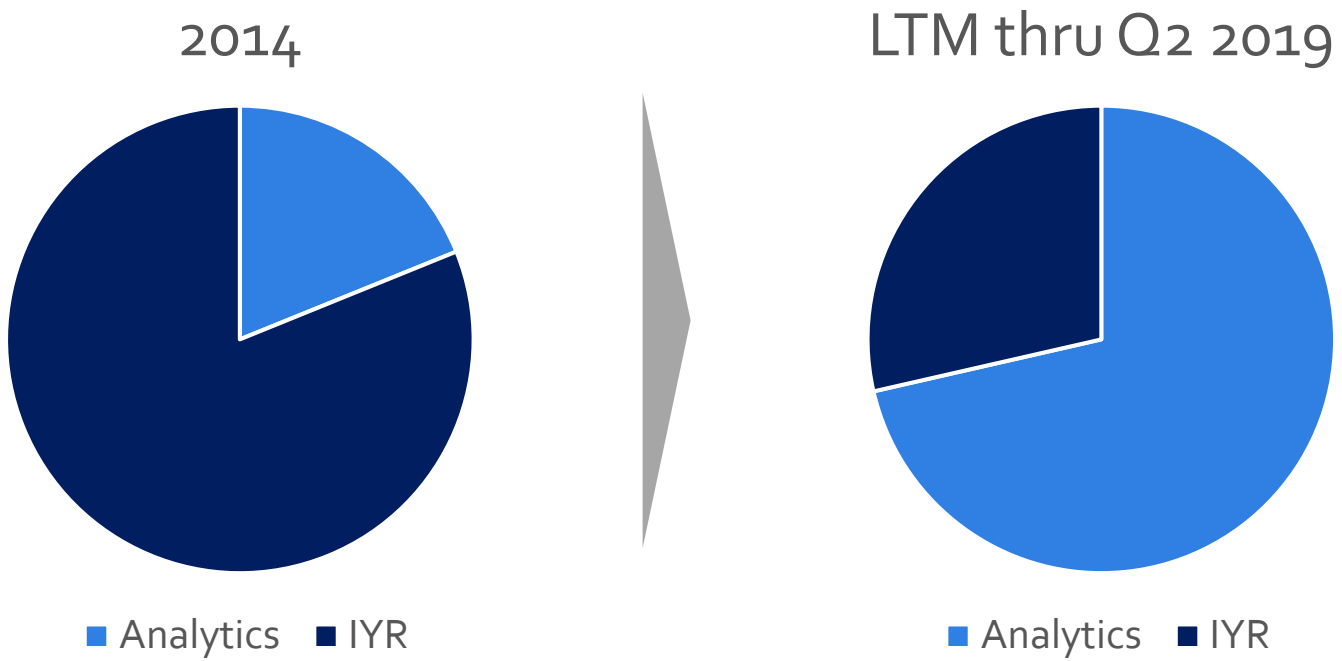
Only half of companies today place a high importance on data analytics, but 83% expect that it will be a core competence in five years.

Number of companies with "highly digitized" functional groups expected to double over next 5 years.

Source: PwC – Industry 4.0 Building your digital enterprise

Shift In Predominant Business Model

Revenue not including Gainshare

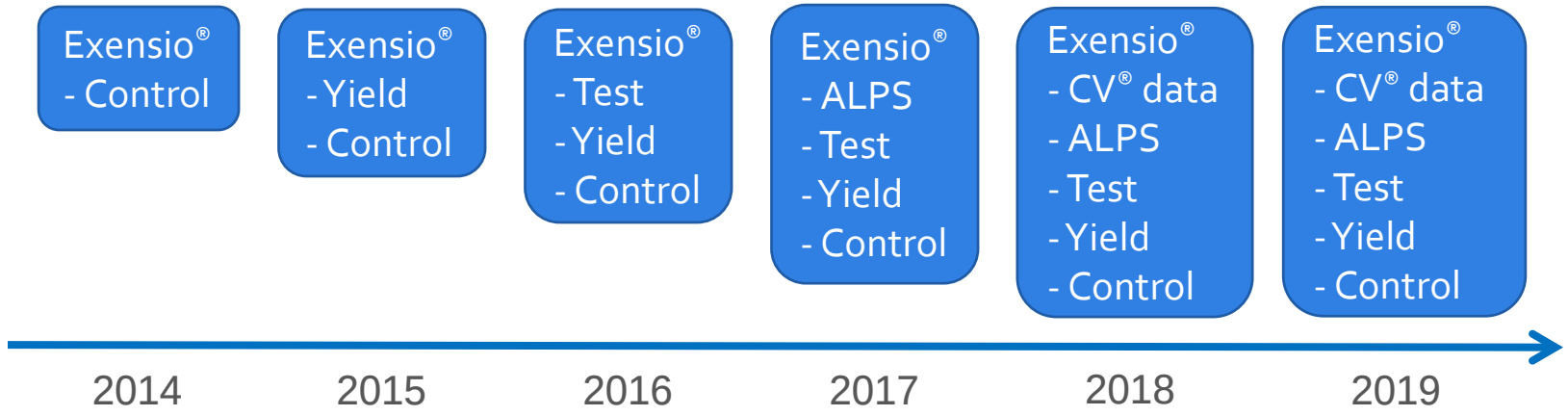


- As value shifts from foundry yield ramp to mass production …
- … PDF's business has shifted to the subscription business model

Migrating Usage of PDF IP and Business Model

- Example: Former IYR customer
  - Stopped leading node development at 28nm
  - Present analytics customer

- Bookings since 2014: >$15M



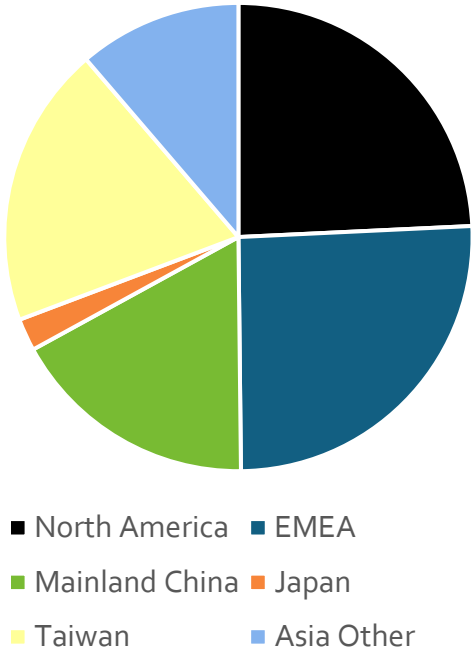
- Historical yield ramp customers are now analytics customers on subscription model

- Applying more PDF IP over broader user base

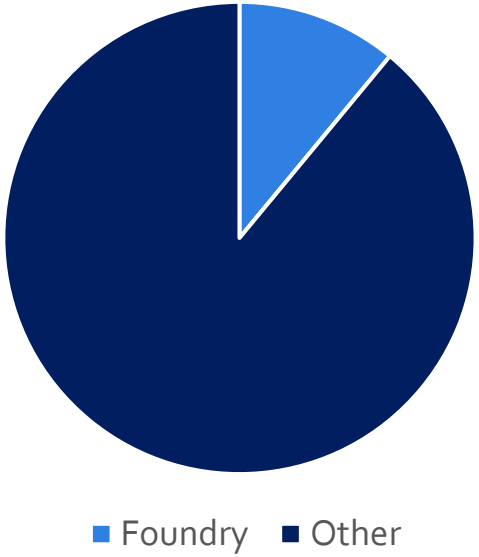
- PDF capability valued for improvements in mass production operations and capability

Shift In Customer Base

Geographic Distribution



Pct. Customers that are Foundries



- As challenges shift to mass production and electrical issues …
- Fabless / design & system companies responsibilities and analytics requirements increase
- PDF's customer base has shifted with these trends

PDF Growth Within Clients

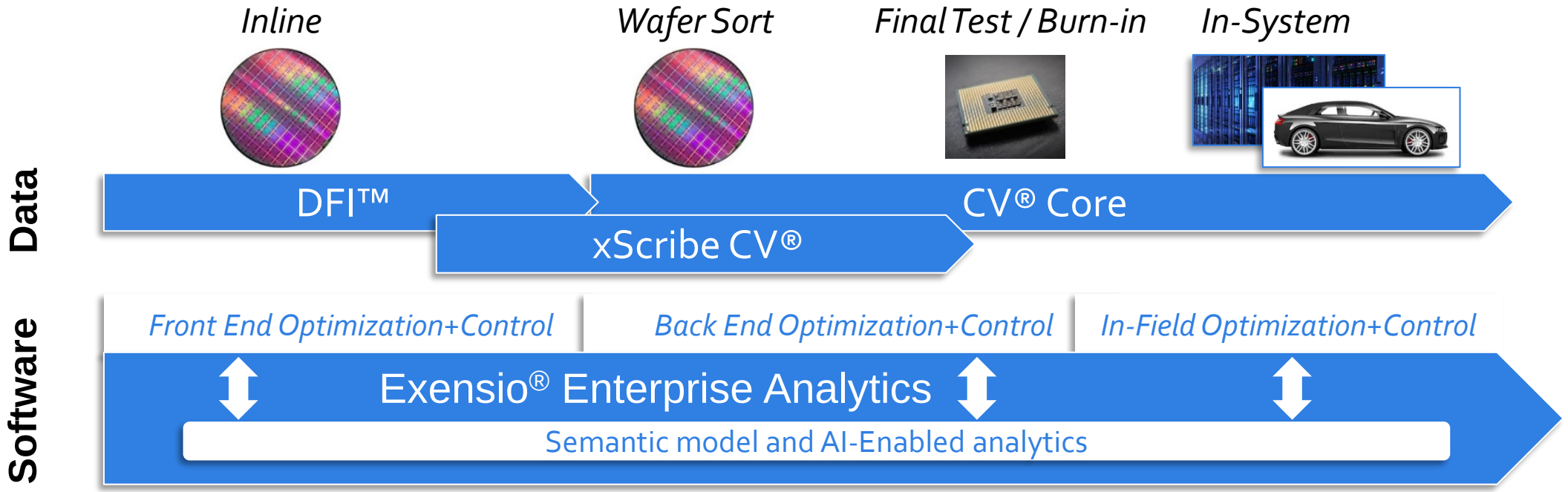
- Example fabless customer:

	2015	Today
Products:	• Exensio® Yield	• Exensio® Yield • Advanced Analytics • Exensio® Test • ALPS traceability
Annual revenue:	$X	$6.4X

- As value and need for analytics increases across the semiconductor supply chain …

- PDF is positioned to increase products and solutions provided to our customers
  - Through breadth of products and solutions
  - As trusted partner on which to standardize

Analytics Growth From PDF Investment

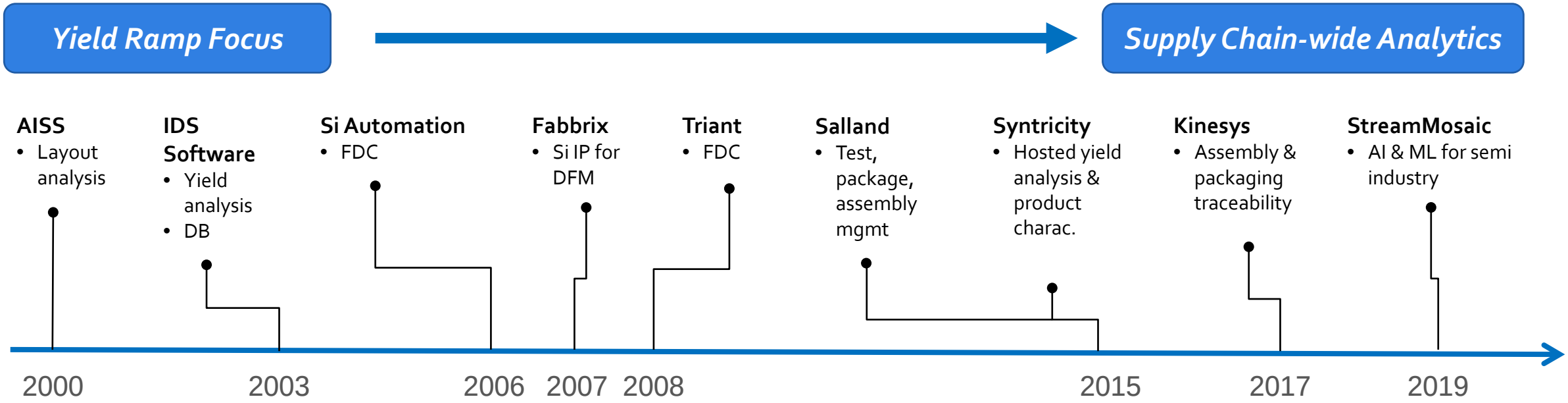


PDF will continue to:

- Expand across the semiconductor supply chain
- Increase customer use and value from our IP
- Increase our analytics revenue

As a direct result of investments we have made and continue to make

PDF Acquisitions Have Been Key Component to Expansion

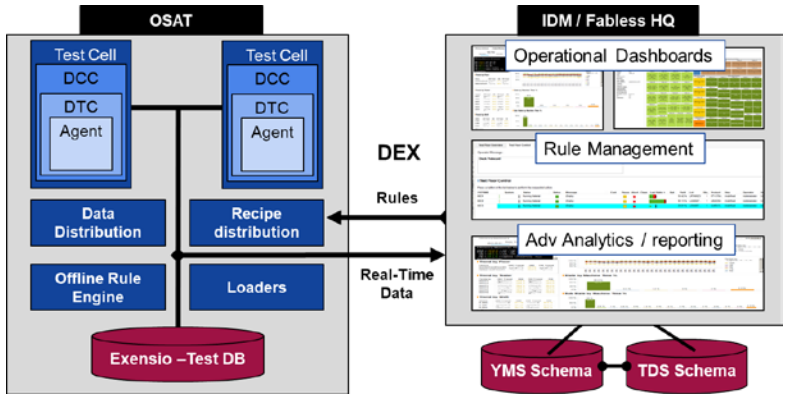


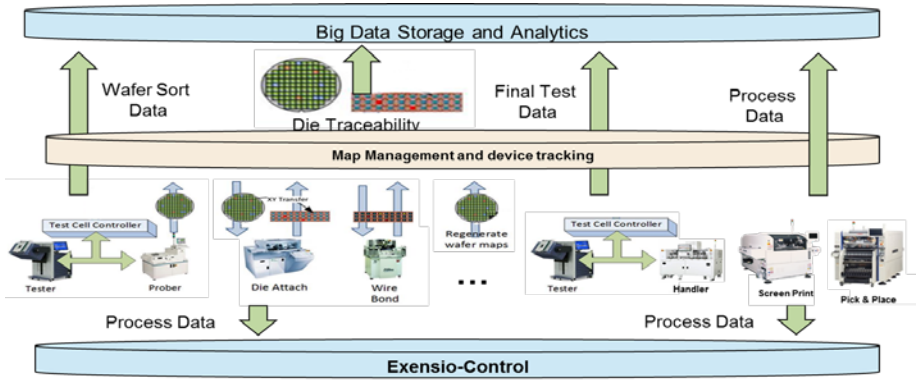
- Acquisitions combined with our R&D have resulted in analytics capability serving fab, OSAT, IDM, and fabless
- The result is a broader customer base and TAM

Return on M&A

- PDF's ecosystem enables us to distribute new capabilities to our customers
- M&A can enable us to grow our subscription business and provide a good return on our assets

- Examples (total bookings vs. purchase price):
  - Salland (2015) return on investment: 4,100%
  - Kinesys (2017) return on investment: 101%



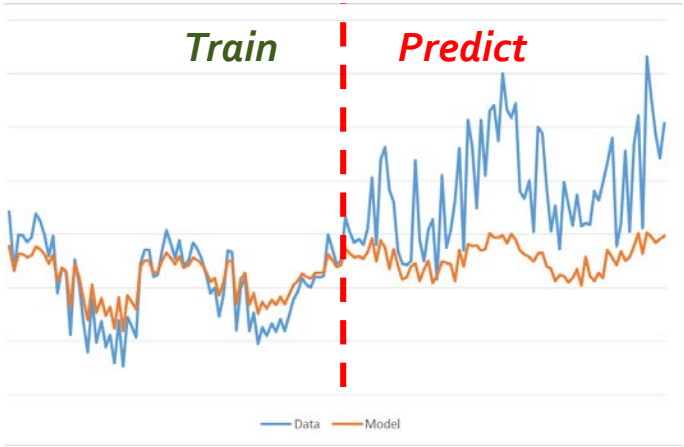


Machine Learning – Necessary, Not Sufficient

MacPaint did not make everyone a successful artist

Kimon Michaels

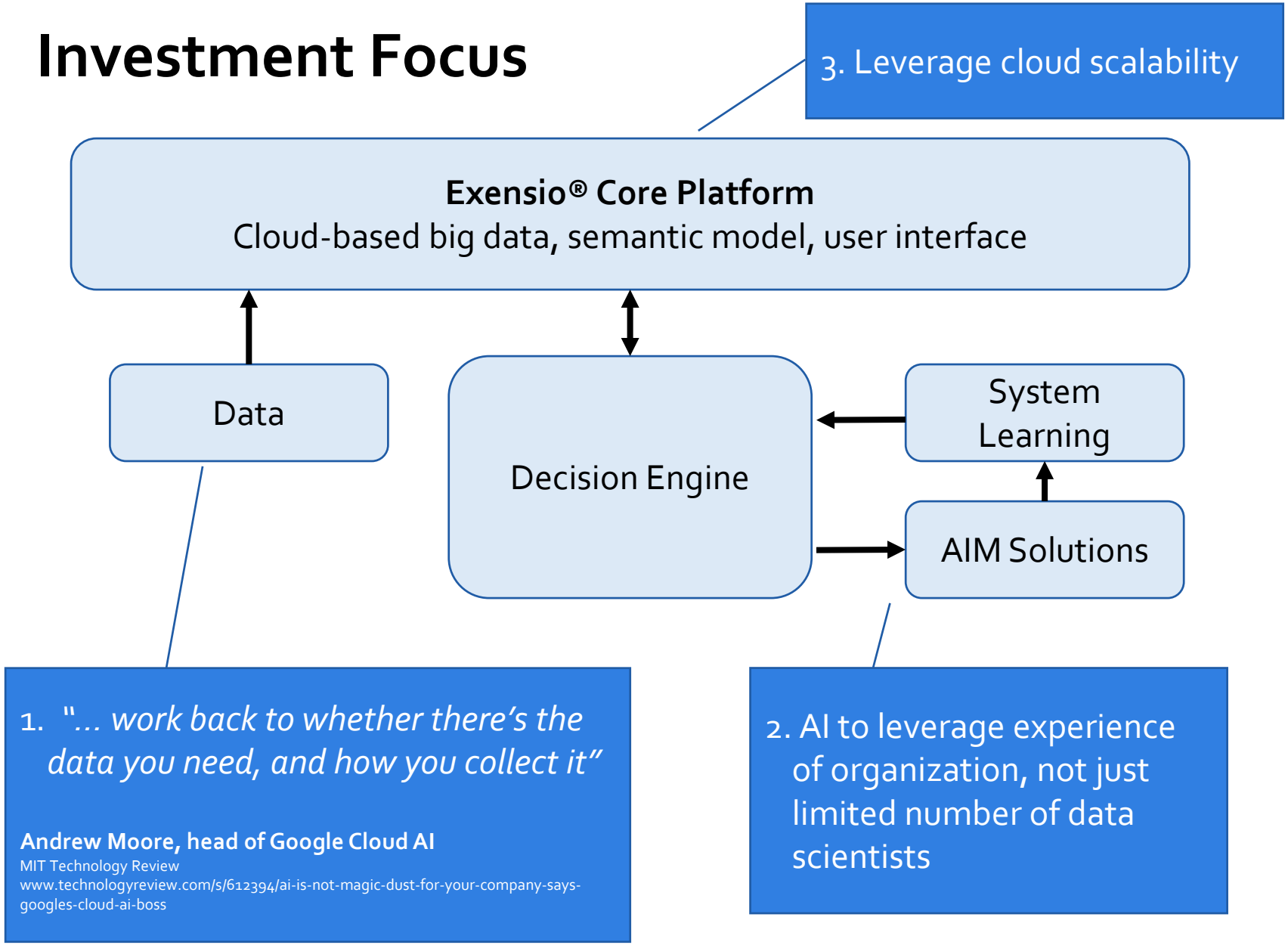
… nor does ML make every model successful



- Machine learning (ML) aides in determining associative relationships in data sets
- ML alone is insufficient to solve challenges in the semiconductor supply chain
  - Semiconductor data is messy and temporal
  - Analytics usage must be broader than just data scientists to be effective

- **PDF continues to invest in requirements to achieve effective solutions**

Investment Focus

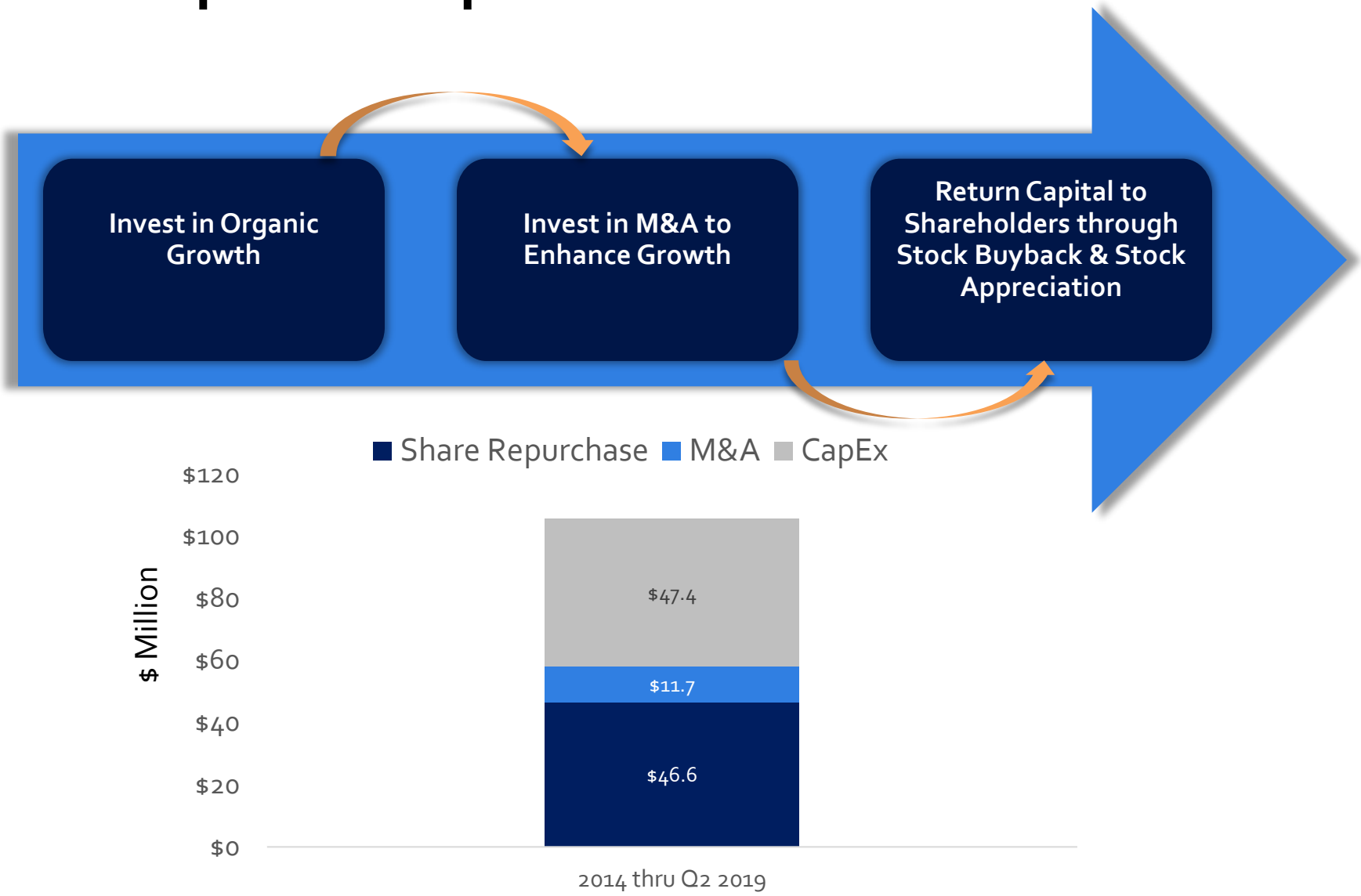


- PDF continues to invest as the leader in semiconductor analytics

1. Differentiated data sources
   - PDF electrical characterization
   - Supply chain-wide data sources
2. Advanced AI algorithms and solutions
3. Cloud capability

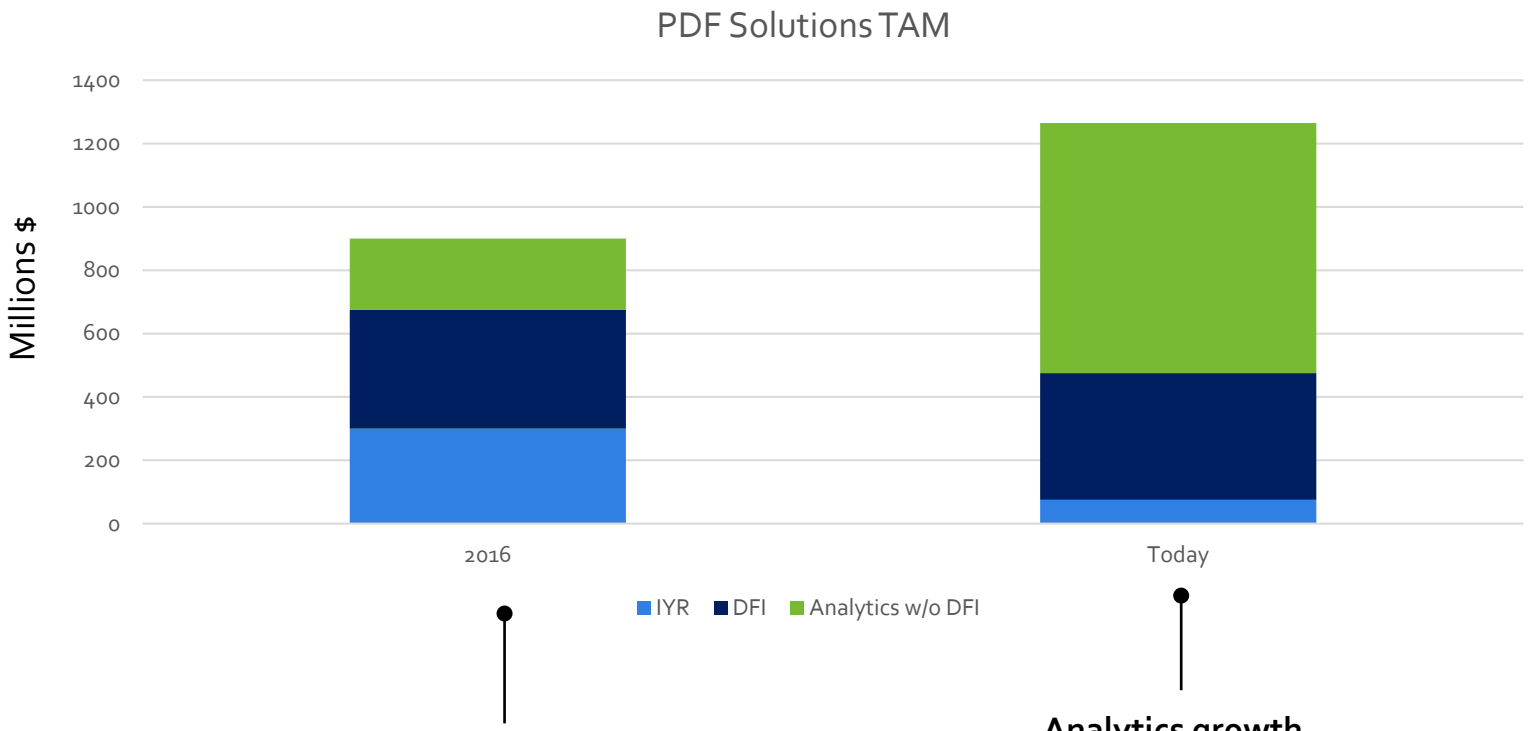
PDF/SOLUTIONS™

Disciplined Capital Allocation



- Capex investments include DFI, CVi, IP, DEX network, and infrastructure
- Cash balance has stayed relatively constant while we
  - Invest in Capex,
  - Make acquisitions
  - Return capital to shareholders through stock buyback

PDF Solutions – Total Available Market



2016 Analyst day
- Median of range presented

Analytics growth
- Expansion across supply chain
- ML & advanced solutions

DFI key use case
- Quality & reliability

- Today, PDF provides the only commercial, supply-chain-wide analytics system
- Growth in analytics TAM being driven from
  - Move to cloud and increased data volumes
  - Additional opportunities in fabless, OSAT, system analytics
- DFI™ TAM growth driven by
  - Need for electrical data for quality and reliability
  - Observability limits of conventional inspection

Thank You

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