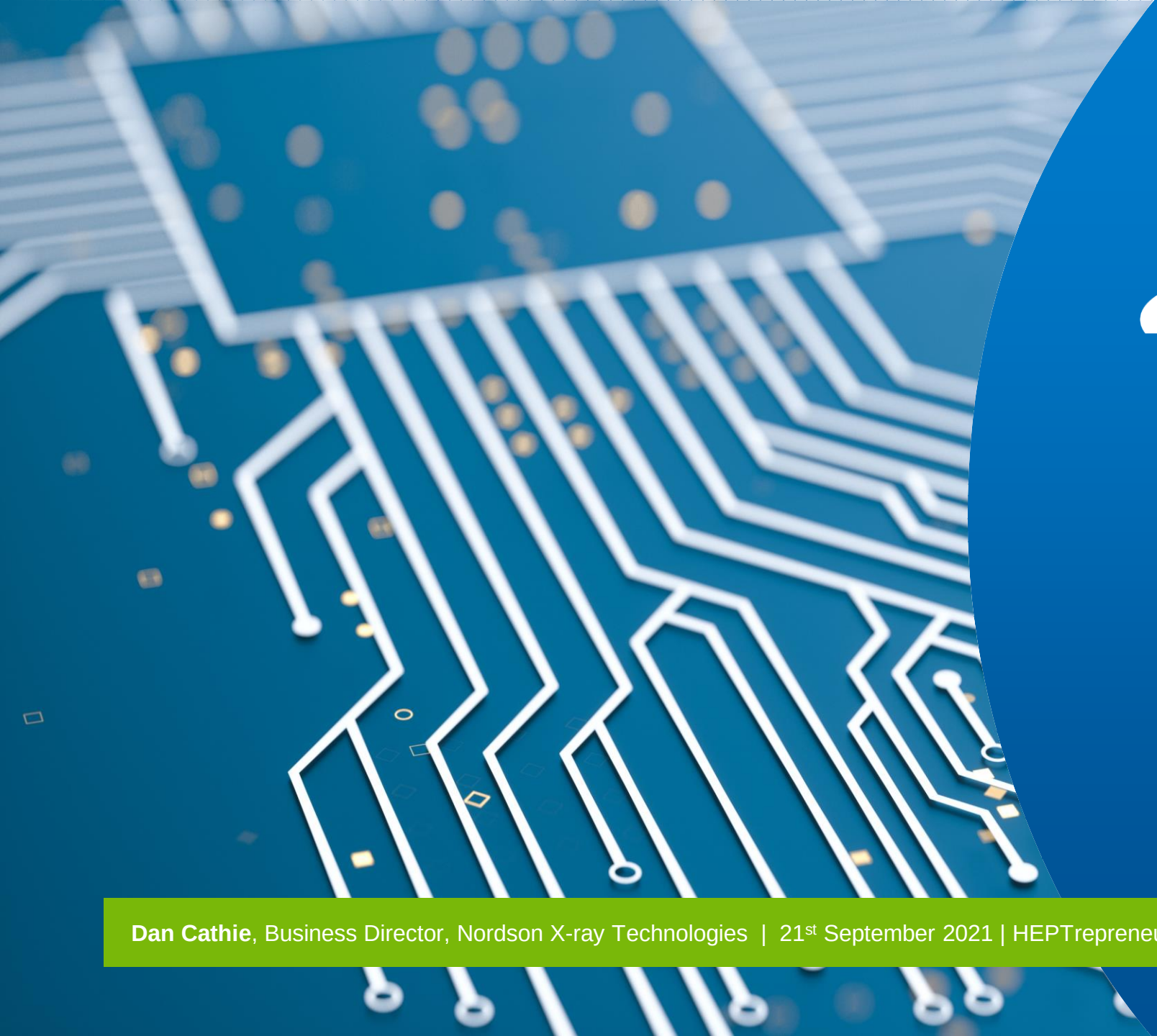


Srk-h + iPct = vM*s-o

[Synchrotron radiation know-how
+ iPhone camera technology
= vivaMOS spin-out]

Dan Cathie, Business Director, Nordson X-ray Technologies | 21st September 2021 | HEPTrepreneurs Episode 4

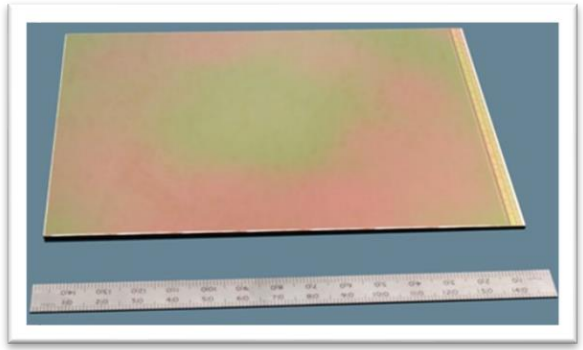
Who am I?

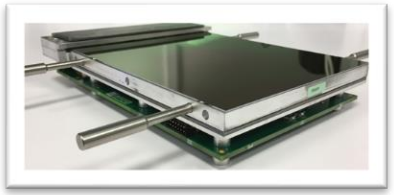
- Dan Cathie, age 45
- I live in Manchester (UK)
- I'm married with 6 children, aged from 7 to 19 years old
- I grew up in Brussels (Belgium) & speak English & French
- I enjoy football, technology, cooking, family adventures, and fixing things
- I have a Masters in microelectronics (1998) and also an MBA
- My early career started with Philips Semiconductors and enabled me to work with many different cultures and people, which I love

Who are vivaMOS?

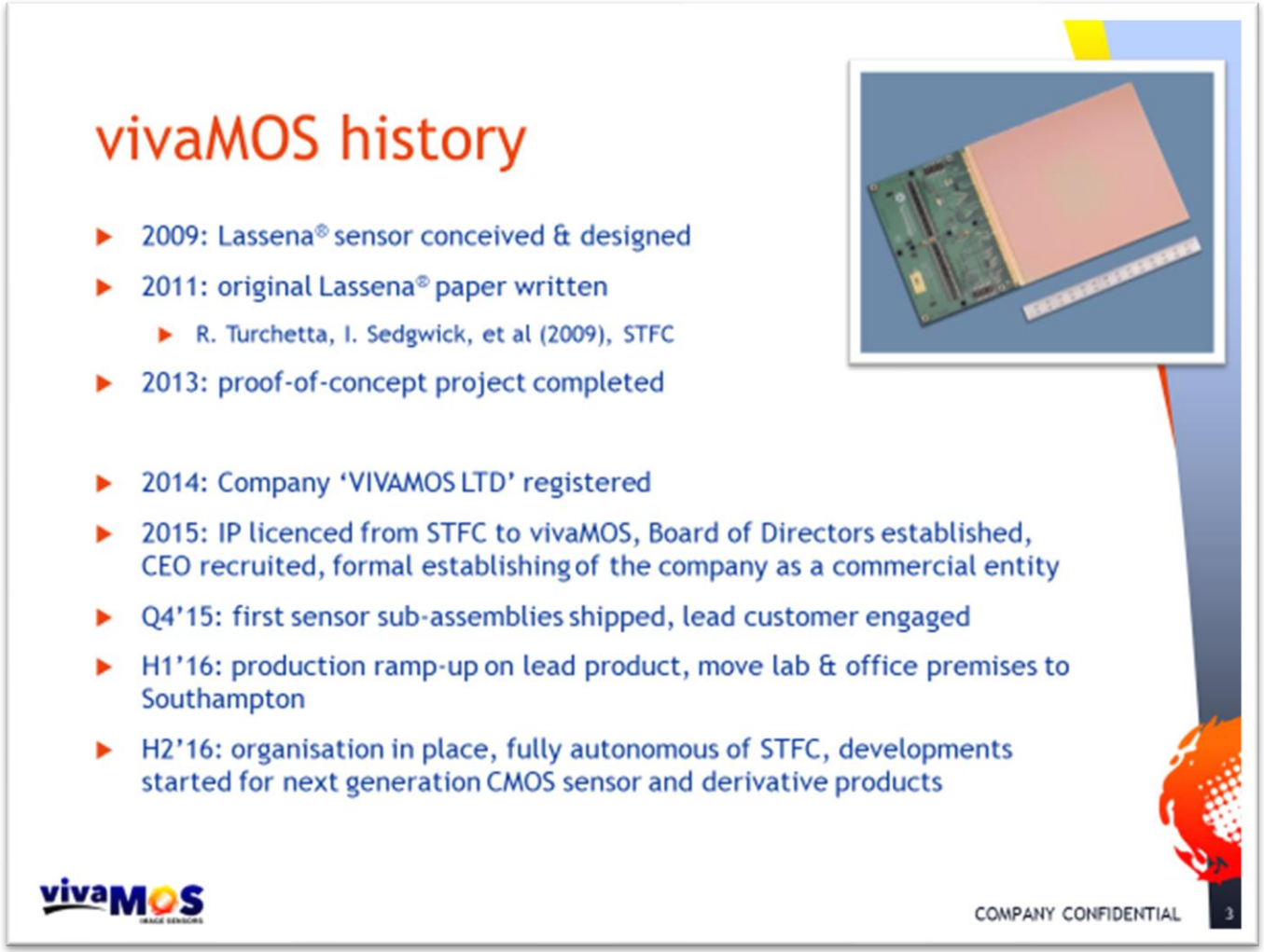
Team photo (2016)

- “Srk-h” [synchrotron radiation know-how]
  - Spin-out from STFC (Rutherford Appleton Laboratories, in Didcot) where Diamond UK synchrotron is based
  - Significant know-how on radiation & particle physics
- + “iPct” [iPhone camera techonlogy]
  - Using CMOS image sensor technology (as developed for digital cameras)
  - Standard semiconductor processing + stitching
  - Low noise & high speed imaging with large scope for further integration of electronics
- = “vM*s-o” [vivaMOS spin-out]
  - Coming out of UK research
  - Spin-out implies research done within research (and IP owned by the parent organisation)





The vivaMOS story – a long time waiting…



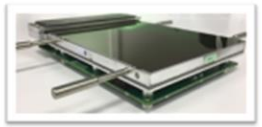
From our first vivaMOS "sales presentation" (2016)

- I was initially appointed by STFC on a short-term (12 month) contract to explore the potential of commercialising the IP
- First Purchase Order received from Dage in Q4'15 (£100k paid up front) which enabled us to start hiring
- Product development and ramp-up in 2016 – tight cash flow!
- Subsequent growth to £3m+ revenue with new customers & good looking future potential
- Trade sale to Nordson in Sept'20 (deal done during Covid)

From Technology to Product

From this (gen1)…

Lassena 2428 sensor



Headline spec

X-ray application requirements	LASSENA features from vivaMOS
High resolution	50 um pixel resolution, 6.7 Mpixels (2400x2800)
High sensitivity (low X-ray dose)	Low noise readout (50 e^-_{rms}), HDR mode
Dynamic imaging	30 fps readout (full frame), much faster in ROI
Ghost-free images	Lag-free images in live imaging mode
Large area image capture	Wafer scale sensor at 12x14 cm, 3-side buttable
Robust under X-ray radiation	Radiation-hard sensor & analogue circuitry

vivaMOS

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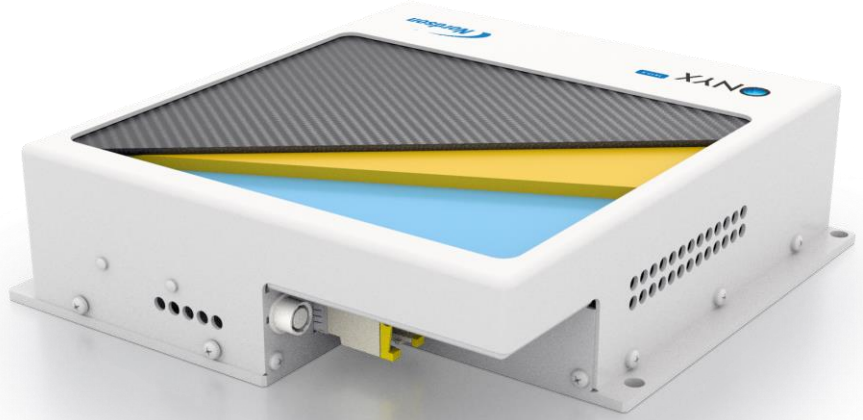
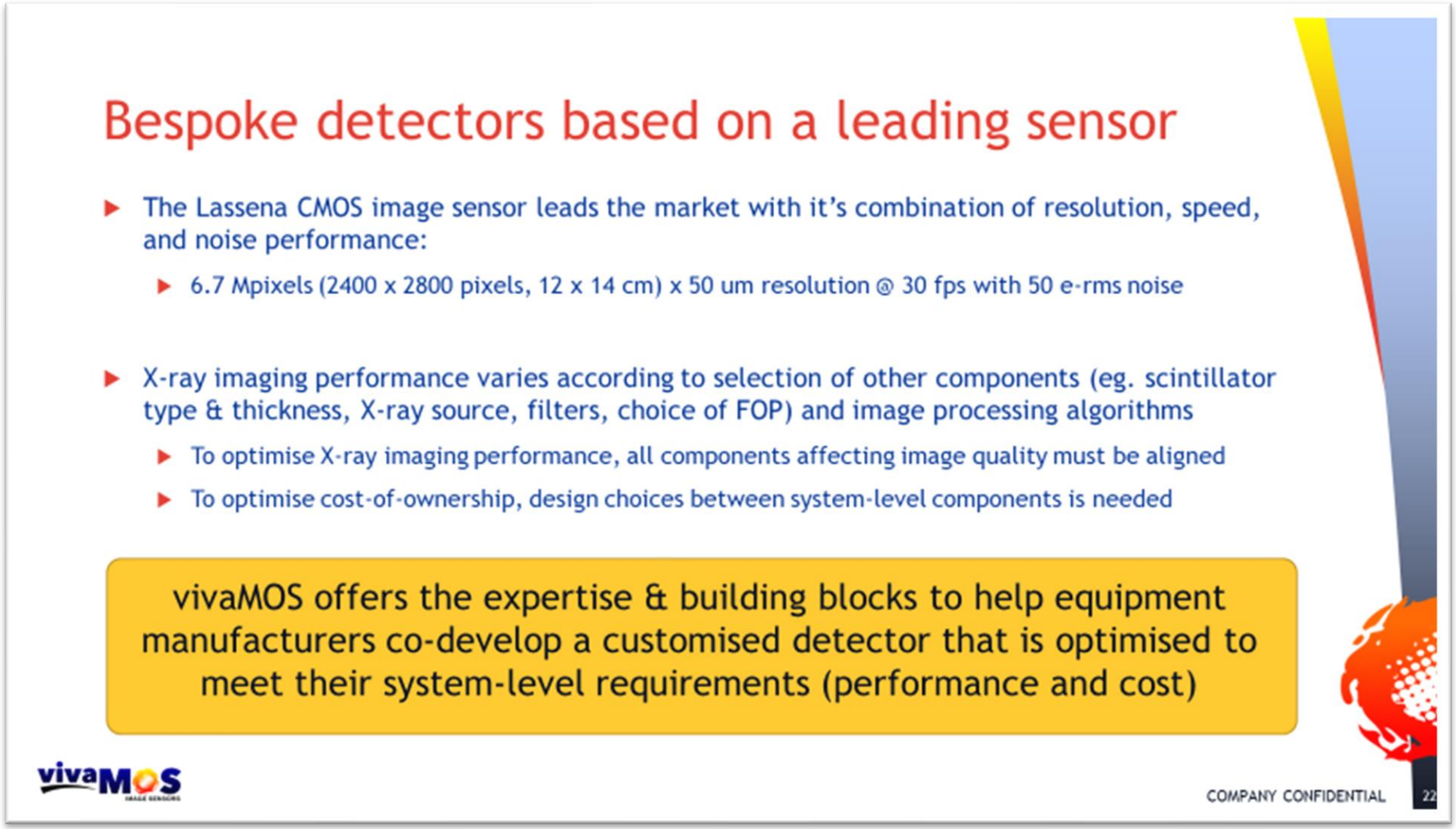


… to this (gen3)!

Nordson

vivaMOS strategy development

- Our unique selling point (USP) regarding technology was actually quite limited
- Custom products means closer links and longer tie-in with customers
- Competitors were large players and not interested in small customers



NXT delivers leading products for high-end systems where our technology brings value to the end user

How?

- **Technology Leadership**: developing best-in-class technology for high-resolution, high-speed, or low-dose X-ray systems
- **Prioritising Long-Term Engagements**: optimising our technologies by delivering application-specific product variants for OEMs & system integrators
- **Differentiated Value Proposition**: building key partnerships with technology-leading OEMs who drive our technology roadmap

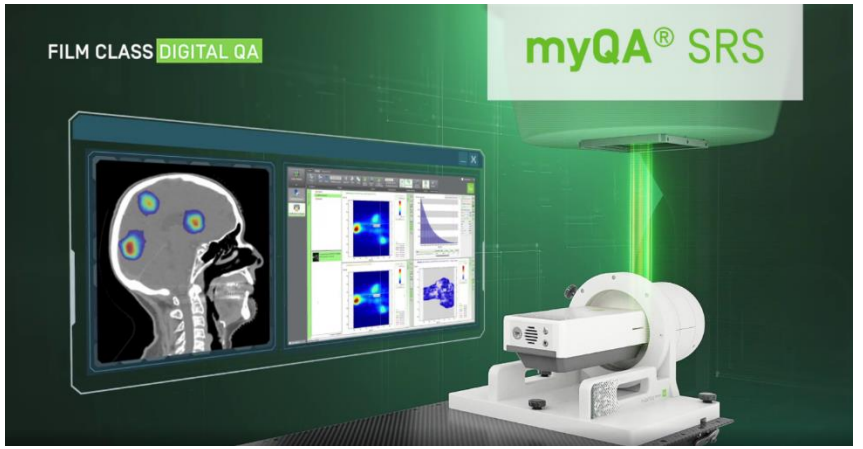
Learnings from a start-up

- “Higher highs and lower lows”!
  - First purchase order / first design-win / first 100 units shipped
  - Nearly running out of cash to pay the team / technical showstoppers / customer line down
- The team & cultural “fit” is critical
  - Spend time hiring the right people, don’t hire if you’re not convinced
  - Agree to part company with people as soon as you know they’re not right
  - Hold people loosely but give them no reason to leave (manage them well!)
- Keep the focus
  - The biggest risk to start-ups is dilution of their limited resources
  - Spend time deciding what to do (the strategy), then do it well
  - Other opportunities may come and be worth the detour, but stay the course!

Nordson

Product Innovation Success Story

- Product: customised high-energy X-ray Detector
- Application: Patient Quality Assurance (QA) for Stereotactic Radio Surgery (SRS)
- Development partner: IBA Dosimetry
- An accelerating timeline:
  - Initial engagement: 2016
  - Proof of concept: 2018
  - Design-win: March 2020
  - Product launch: September 2020
  - Production start: January 2021
- Multi $m annual sales revenue



Introductions and initial clinical work done with a “light touch” thanks to close links with research partners:

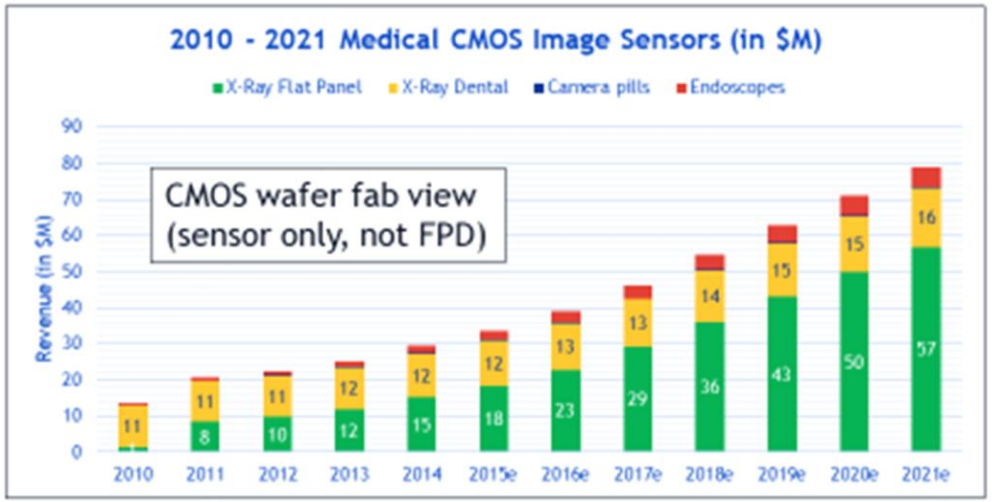
Excellent collaborative project management (despite C-19) leading to on-time completion and production ramp of a complex custom product

More info: weblink

The future (still)…

CIS for medical X-ray – a new solution

- FPD market size ~$1.4B (2015), mostly non-CMOS today
- Anticipate ~20% YoY growth mid-term for CMOS Flat Panel Detectors
  - CMOS FPD = CMOS sensor + FOP (optional) + scintillator + DAQ board + housing



Yole Développement © May 2016

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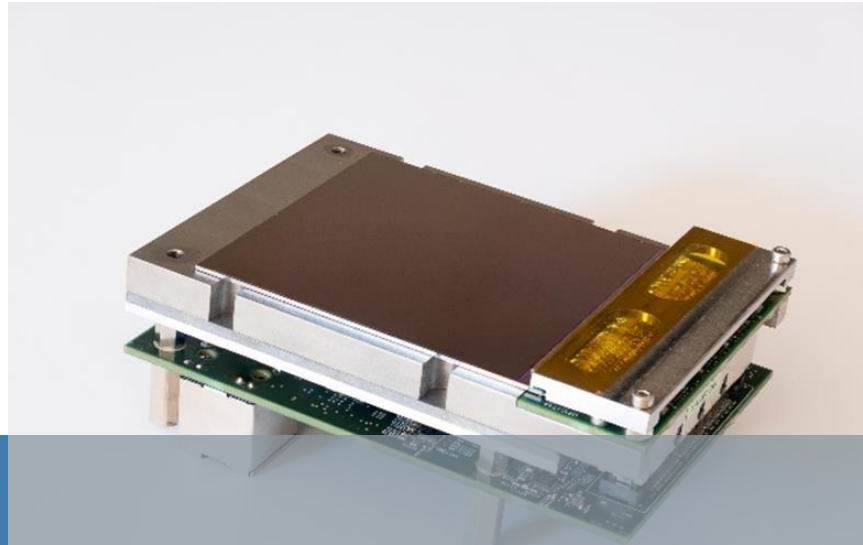
NXT Product Range

CMOS Flat Panel X-ray Detectors

Proprietary CMOS active pixel sensor
High sensitivity rad-hard pixel array
Pixel size & pitch 50x50 um
High full resolution frame rates
Imaging area from 6x6 to 24x24 cm
Several scintillator options

Microfocus X-ray Sources

Sealed transmission tube technology
Feature recognition from 100 nm
High flux without loss of resolution
Wide cone beam angle 175°
High stability High Voltage PSU
Zero maintenance with long lifetime



X-ray OEM Products

Custom features & software
Early access to technology roadmap
Cost-optimised solution for OEMs
OEM product branding

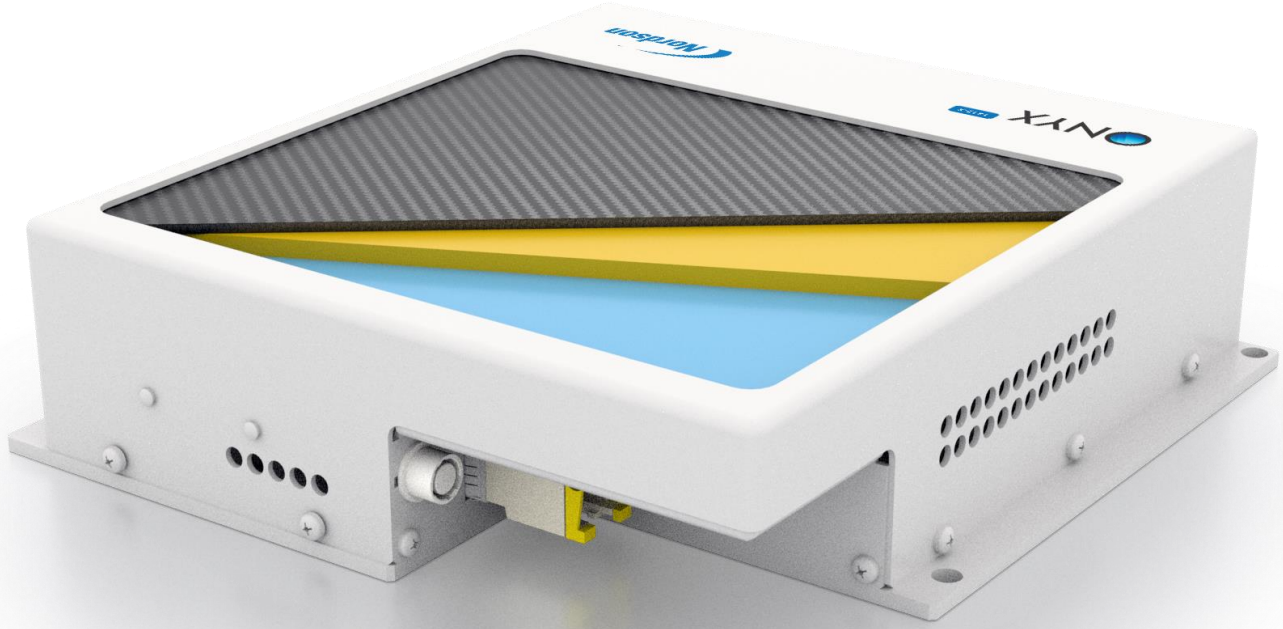
Nordson

NEW

ONYX 1412-X detector

Features and Benefits

- CMOS Active Pixel Sensor technology
- 2768 x 2376 (6.6M) pixels
- 50 µm pixel size
- 45 fps full resolution frame rate
- 10 GbE data interface
- 16-bit data output
- High resolution CsI scintillator on Fiber Optic Plate
- Active area 14 x 12 cm



Nordson

NEW

ATHENA 2424-X detector

Features and Benefits

- CMOS Active Pixel Sensor technology
- Active area 24 x 24 cm
- 4800 x 4800 (23M) pixels
- 50 µm pixel size
- 10 fps full resolution frame rate
- Fiber Optic Plate with choice of CsI or Gadox scintillator
- 10 GbE data interface (x4)
- 16-bit data output

Nordson

NEW

BRIGHTHAWK NT100 & HV160

Features and Benefits

- High brightness 160 kV source & power supply
- High magnification 0.5 mm focus to object distance
- 100 nm feature recognition (*)
- Wide 175° angle exposure
- Zero maintenance
- Sealed transmission tube technology with LaB_6 crystal electron source

(*) Achieved under controlled conditions

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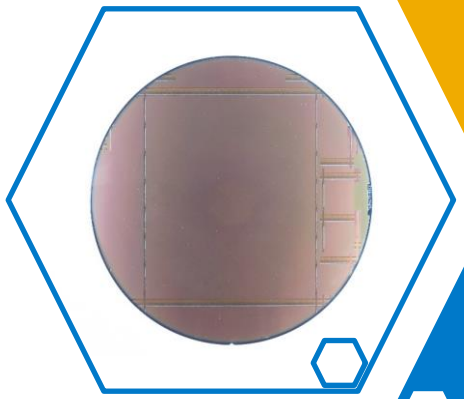
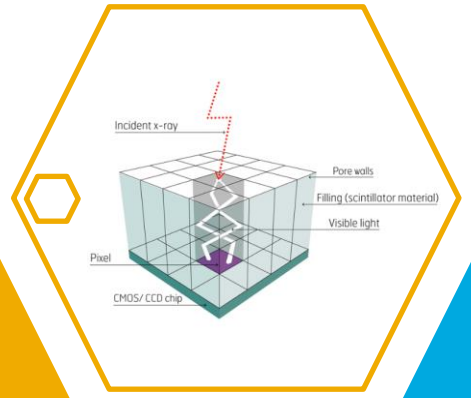
NXT Technology Toolbox

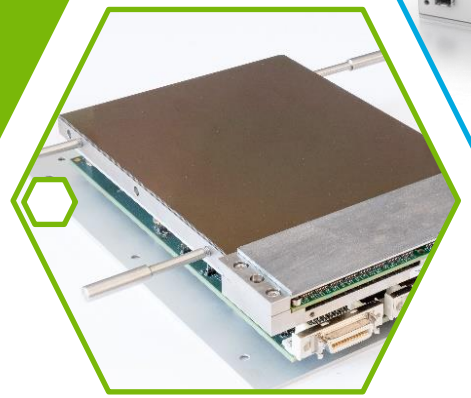


Proprietary large-area CMOS image sensor

Patented collimated scintillator technology



On detector image processing modes



Large-area tiled detector technology

World-leading microfocus sealed transmission X-ray tube

NXT – technology & product range

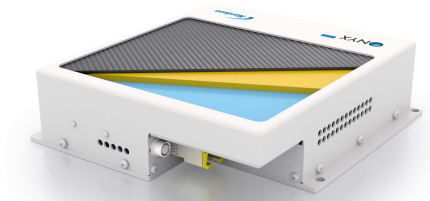
Technology toolbox

- Proprietary high-resolution large-area CMOS image sensor
- Innovative imaging modes for ultimate application flexibility
- Tiling technology with 1 pixel gap (50 um between CMOS sensors for best 3D imaging performance)
- World-leading high-resolution microfocus X-ray tube
- Collimated scintillator technology for ultra-high detector resolution (*)

Product range

ONYX detector

- Gen1 launched 2016 with >1000 units sold
- High resolution, high speed, low noise
- 50 um pixel, 45 fps



ATHENA detector

- Launched 2020
- 24x24 cm active area
- 50 um pixel pitch
- Single pixel gap between tiles

BRIGHTHAWK source

- High resolution X-ray tube
- Gen 1 launched 2006 with >2000 units sold
- High resolution at high power
- High stability power supply
- Zero maintenance

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(*) Not yet released

Customised CMOS detectors for life-saving X-ray applications