A quantum leap in production technology..

And the bumpy road to get there
Introduction OTB Group
### Organization

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<td>Tool &amp;Proto Shop</td>
<td>Production</td>
<td>Purchase &amp; Logistics</td>
<td>Production</td>
<td>Engineering</td>
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- New development
- Supporting other BU’s
- Opthalmic, Car glazing
- Energyhouse etc. etc.

- Inline solar-cell production equipment
- Tabbers
- Anti-reflection deposition tools

- Inline display equipment for SMOLED and OLED

- Development of high accuracy industrial print heads
- Print strategy software
- Print material recipes

- Application research for organic electronics
Minimizing process steps and operator intervention
Production equipment dedicated for a small group of products
Balancing and reducing of tact times
Elimination of buffers
Integration in one machine
Reduced inspection steps to one at the end
Fast feed back loops enabled by short throughput times
Maintain product orientation trough process
Philips ODM
ODME
Toolex
OD&ME

Worlds 1st inline CD production system: monoliner MKI

Philips ODM
ODME
Toolex
OD&ME

Worlds 1st inline CD mastering system: AMS

Philips ODM
ODME
Toolex
OD&ME

Worlds 1st inline soft contact lens production system

Philips ODM
ODME
Toolex
OD&ME

Worlds 1st inline SOLAR cell production system

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Toolex
OD&ME

inline CD-R production system: Dye-Line

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Toolex
OD&ME

Worlds 1st inline DVD-R production system: Profi-Line

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ODME
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OD&ME

Fully electrical Injection Molding System: MoldPro

Philips ODM
ODME
Toolex
OD&ME

Thin film SiN deposition tool: DEPx

Philips ODM
ODME
Toolex
OD&ME

Worlds 1st inline PLED production system: PCAP

Philips ODM
ODME
Toolex
OD&ME


History of Ron Kok

- **1968**: Started as plastics engineer at Krauss Maffei A.G.
- **1979**: Engineer at Philips Plastic Factory (laserdisc/CD)
- **1982**: Krauss Maffei Sales Office NL
- **1985**: Started Rokoma B.V.
- **1987**: First In-line production machine for CD replication MC. (OD&ME)
- **1991**: First in-line Mastering equipment and take over of Optical Disc Mastering of PDO. (ODME)
- **1995**: Sale of shares of ODME and Buy Out OTB Engineering B.V.
- **1999**: First in-line production line for PV solar cells
- **2001**: Acquisition by OTB Group of Toolex activities (former ODME operations)
- **2005**: Sales of all optical disc production units to VDL.
- **2005**: First in-line production machine for P-OLEDS
OTB Engineering
OTB Engineering is Inventing, designing, and building inline mass production equipment with a guaranteed output volume of high quality products with a low total cost of ownership.
OTB’s working method

Polymer Oled production machine

Fast SiNx Deposition equipment

Industrial Printer

POP Phase

Proto Phase

Pilot Phase

Production Phase
Full electric clampless molding mc
### OTB Achieved results

<table>
<thead>
<tr>
<th>Product</th>
<th>Batch</th>
<th>In-line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar cells</td>
<td>3 MW/year</td>
<td>50 MW/year</td>
</tr>
<tr>
<td></td>
<td>160 operators</td>
<td>25 operators</td>
</tr>
<tr>
<td></td>
<td>5000 m²</td>
<td>100 m²</td>
</tr>
<tr>
<td>Compact Discs</td>
<td>€ 3.5 / CD</td>
<td>€ 0.12 / CD</td>
</tr>
<tr>
<td></td>
<td>20 Million/Year</td>
<td>8 Million/year</td>
</tr>
<tr>
<td></td>
<td>400 operators</td>
<td>1 operator</td>
</tr>
<tr>
<td></td>
<td>100 m²</td>
<td>3 m²</td>
</tr>
<tr>
<td></td>
<td>80% yield</td>
<td>&gt;97% yield</td>
</tr>
<tr>
<td>Contact lenses</td>
<td>€ 0.40 / Lens</td>
<td>€ 0.12 / Lens</td>
</tr>
<tr>
<td></td>
<td>42 Million/year</td>
<td>42 Million/year</td>
</tr>
<tr>
<td></td>
<td>25 operators</td>
<td>1 operator</td>
</tr>
<tr>
<td></td>
<td>180 m²</td>
<td>10 m²</td>
</tr>
<tr>
<td></td>
<td>70% yield</td>
<td>90% yield</td>
</tr>
</tbody>
</table>
OTB Display
OTB Display
Designs, develops and delivers in-line production equipment including the process to manufacture OLED displays, and offers the complete display know-how.

Features of the manufacturing solution
- Highly automated in-line manufacturing equipment
- An integrated process for guaranteed production volume
- Technology and support in all phases up to and incl. mass production

Benefits
OTB Display enables customers in the display industry to rapidly ramp-up to a guaranteed mass production volume against low cost
In-line p-OLED production system

In-line mass production equipment for polymer OLED displays

PEDOT/LEP Inkjet printing → Cathode deposition → Thin film Encapsulation → Anti-scratch coating
In-line production equipment for small molecule OLED displays
Under development

Small molecule Vaporization → Cathode deposition → Thin film Encapsulation → Anti-scratch coating

Turn-key solution with Kodak
Comparison of LCD vs OLED display from OTB Display

1.1” OLED displays of ca. 0.7 mm thin

2.6” Full color OLED display

1.5” Full color OLED display
OTB Solar is a leading company in the design, engineering, development and manufacturing of inline production equipment for the solar industry.

OTB Solar strategy:

- Inline concepts
- Tailor made solutions
- Breakthrough technologies
- Partnership with customers

From equipment delivery to process know how and After Sales support
Inline Solar Cell manufacturing equipment

- Fully inline PV production platform
- Integration latest technologies:
  - Wet chemical
  - SiN deposition,
  - Screen printing processes
- Up to 1450 PV Solar Cells / hour
- Capacity up to 40 MW_{Peak} / year
- MONO & MULTI process available
Inline SiN deposition system for ARC \textsuperscript{DEP}X\textsubscript{750}, \textsuperscript{DEP}X\textsubscript{1000} & \textsuperscript{DEP}X\textsubscript{1500}

- Ultra fast PECVD with Linear Motor System
- Up to 1440 PV Solar Cells / hour
- Cell efficiency $\geq 16\%$ (Mono Crystalline)
- MONO & MULTI process available
The first in-line integrator in the world, ref. Shell

Low Total Cost of Ownership (TCO)

Superior process know-how available

DEP<sup>x</sup> has smallest footprint

Local support available from OTB offices (Eindhoven, USA, Hong Kong, India, Singapore)

Standard DEP<sup>x</sup> accommodates 125/156 mm cell sizes

Different concepts allow different throughputs
OTB Energyhouse
Independent zero emission solutions

23rd January 2007, Dutch business round table, Zurich

Cees Collart, Projectmanager Energyhouse
• 2 years ago
  Technology Pioneer at World Economic Forum
• Expression of disappointment about energy-politics in a forum at WEF
• Vision: from central to decentralized power generation, per individual (group of) house(s)
• Independent from gas- and electricity network
• CO2- free
Vision

- Fossil fuels limited and taxed very heavily
- Sun and wind unlimited and for free
- Solution in that area available
- Technology proven, but not optimized, nor integrated
- Absolute carbon free solution
- Turn around efficiency of grid 20% energy house 75 %.
- Price comparison PV / Grid is unfair.
- Energy consuming versus energy investing
- Unsensitive for oil market situation
• Research, development, building, testing
• No 1 supplier of de-centralized and integrated solutions for the generation, storage and supply of home-energy
• 100% based on renewable energy (solar/wind)
• CO2 free
Scheme (1)

- PV Modules
- Electrolyser
- Hydrogen storage
- Fuel Cell
- Inverter
- Backup Hydrogen tanks
- PLC
- Heat Pump
- 230 VAC

Other DC power sources
(Battery)
Wind
✓ House
✓ Sun / wind
✓ Renewable energy system
✓ Electrolyser
✓ H₂ storage
✓ Fuel cell / HPC / HP
✓ Inverter
✓ Control unit

Total system
Energyhouse
The bumpy road to realize innovations

- Concept is proposed
- Disbelieve by market and production engineers
- Proof of principle is built
- System is proven
- Not invented here!
- Can never work, too simple
- Management is put under pressure by their staff
- Management often in doubt and afraid to pull through.
The bumpy road to realize innovations

- Unions are against
- Internal report to underline company threats, in case of implementation of new technology
- In case OEM-product market leaders will suggest failure or total ignorance
- Put in production to show capability
- Market introduction/confrontation
Key factors for success and innovations

• Focus on strength
• Be sure about business opportunity
• Make milestone decision planning for go or stop
• Keep in mind “windows of opportunity”
• Be not afraid for failure
• Make step by step progress planning
• Follow your hart
• Make RoI calculation
Focus on strength

- Only start a new business if you are sure about technical achievability
- Be sure this is your core business, or “could become”
Business opportunity

- Make a reverse calculation, based on finished product end price and ROI
- Never calculate on cost price / net gross margin
- Total investment should not exceed 30% of total estimated and cost of development and market-introduction of 3 to 5 years
Milestone decisions

• Make every month (or day) a milestone decision, to go or stop, based on your starting business plan
• Do not be afraid to stop, if your targets cannot be achieved
• Do not rely on magic before 03.00 a.m.
• Under pressure everything gets liquid
• Under war conditions the best solutions are found
Make ROI calculation

• During the process market situation can change dramatically
• Assumptions made, could be wrong
• Upfront investment up to cash positive situation, should not exceed more than 30% of total expected earnings or not longer then 50% of product life time cycle
Follow your Heart

- Everybody knows inside whether he is still winning or loosing
- Make a status quo sheet and keep it updated so you can make up your mind
- You are all alone in this
- Be a “fore checker” and not a”back checker”
- Do not try to escape from difficult decisions
Window of opportunity

- Every new product has a life time cycle
- Be sure you are still within this cycle
- If not: stop in time
- Do not get a prisoner of your venture capitalist or be afraid for loss of face
partnerships

TU/e

ECN

DFF

Cambridge Display Technology

EPIA

European Photovoltaic Industry Association

Fraunhofer Institut Solare Energiesysteme
Success is emotion but no guarantee for the future
THANK YOU

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