COSMIC will generate an organic CMOS technology platform from design to manufacturing level.

COSMIC will produce highly complex lead applications covering the whole FOLAE market with different manufacturing modes.
COSMIC develops one organic CMOS Technology Platform including 3 complementary manufacturing modes: W2W, S2S, R2R.

- **W2W** (~ 10000 OTFT)
  - Flexible displays
  - ADC for thermal sensor
  - 32bit RFAD

- **S2S** (~ 500 OTFT)
  - Large area sensors
  - 4bit RFAD

- **R2R** (~ 200 OTFT)
  - Large area sensors
  - 4bit RFAD

Cost / # transistors and Functionality are illustrated along the axes.
**Complementary Manufacturing Modes and associated application areas.**

<table>
<thead>
<tr>
<th></th>
<th>W2W</th>
<th>S2S</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead application</td>
<td>Line-driver for display, Arithmetic logic unit</td>
<td>ADC for thermal sensor 32 Bits RF-ID Silent Tag</td>
<td>Low level signal processing for T sensor (Operational Amplifier) 4Bit-RF-AD (Silent Tag)</td>
</tr>
<tr>
<td>Technology</td>
<td>Diameter 150 mm foil on carrier Clean room High yield</td>
<td>320x380 mm sheets Additive printing and corresponding processes Clean room Medium yield</td>
<td>R2R processes web 210mm Flow boxes Continuous and stop-and-go processes Lower yield</td>
</tr>
</tbody>
</table>
| Market segment of the lead Application | Line-driver: E-paper, OLED displays; ALU: every integrated system that needs computing | • Temperature sensor for skin and building integration  
• RF-authentication of consumable goods | • High throughput large area sensors  
• RF-authentication of consumable goods |
| Other potential markets | Displays, Sensor matrixes, microprocessors, integrated electronics systems … | • All sensor and actuator on foil applications  
• Digital to analogue converters and mixed signal integrated systems | Large-area sensing, Large volume organic electronics addressing low-cost segments |
**COSMIC** - Breakthroughs and expected results

**Circuit and demonstrators**

*First fully printed A/D-Converter using analogue organic CMOS.*

*First flexible organic line driver for display or comparable complexity IC.*

*First organic RFID with receiver radio.*

*First organic ALU!*

**Materials and printing processes**

- New materials and printing processes with high mobility and stability under stress
- Balance p-TFT and n-TFT characteristics: \( \mu_n \sim \mu_p \), \( |V_{thn}| - |V_{thp}| < V_{DD}/4 \)
- Common and compatible technology for n and p: Dielectric, S&D level
- Compatible interconnection technology for circuit processing
- Controlled resistors

**Design/conception and model**

- Process tolerant design
- Maximised noise margin
- Organic SC models and simulation tools
- Organic Analogue CMOS Design
- Charge transport in LC polymers

**Reliability**

- Transistor parameter reproducibility
- Minimise stress and stress sensitivity
### Technical Concept

**Lead application driven technology**

<table>
<thead>
<tr>
<th>Line driver or comp. IC</th>
<th>ADC, Silent tag</th>
<th>Silent tag and Sensor-Amp</th>
</tr>
</thead>
<tbody>
<tr>
<td>high complexity</td>
<td>large area, printable, mixed-signal</td>
<td>R2R, large volume</td>
</tr>
</tbody>
</table>

- Process, sample material and data exchange

---

4 loops between Specifications, Design, Evaluation and Technology:

1-2 OTFT, INV, ROSC

3 gates comp: building blocks

4 lead applications

Increasing complexity
## Workpackage Structure

<table>
<thead>
<tr>
<th>WP</th>
<th>Title</th>
<th>WP’s Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP1</td>
<td>Lead Applications Specification and Exploitation</td>
<td>Generation of specifications from industrial requirements. Evaluation of the valorisation potential</td>
</tr>
<tr>
<td>WP2</td>
<td>IC Design &amp; Test</td>
<td>Design of test structures, analogue and digital building blocks and complex ICs for the lead applications</td>
</tr>
<tr>
<td>WP3</td>
<td>CMOS Technology Platform</td>
<td>Development of CMOS OTFT technologies fitting analogue and digital applications</td>
</tr>
<tr>
<td>WP4</td>
<td>Reliability and Modelling</td>
<td>Analyse, measure and model the devices</td>
</tr>
<tr>
<td>WP5</td>
<td>Lead Applications Design and Evaluation</td>
<td>System design, fabrication and verification of the lead applications</td>
</tr>
<tr>
<td>WP6</td>
<td>Management</td>
<td>To ensure an efficient management of a large project and to provide training and dissemination</td>
</tr>
</tbody>
</table>

Table 1.3a. Short description of the work-packages
Work packages

WP1: Specifications: IMEC
IMEC, ST-I, CC, Friendly, TUE.

WP2: IC Design: TUE
ST-I, TUE, UNICT, IMEC, CC

WP3: CMOS Technology: CEA
FRAUNHOFER, CEA, IMEC, TNO, Flexink, TUB.

WP4: Reliability and modelling: CNR
ST-I, CNR, TUE.

WP5a and WP5b: Lead applications: ST
ST-I, CEA, IMEC, FRAUNHOFER, TUE, CC, Friendly.

WP6a: Scientific coordination: FRAUNHOFER.

WP6b and WP6c: Management, Dissemination: FRAUNHOFER.
Interaction diagram of COSMIC

Very close iteration loops between:
Design,
Technology
and
Applications

WP1: IMEC; WP2: TUE; WP3: CEA; WP4: CNR; WP5a,b: ST-I, WP6a,b,c: FRAUNHOFER
Timeline of COSMIC

**WORKPACKAGE**

**EVALUATION/MODELLING**
- OTFT, INV, ROSC, 1st gen
- Gates, Flip-Flop, OP-amp, comparator 2 lps.
- Line driv. or IC, silent tag, ADC, ALU 2lps.

**SPECIFICATIONS**
- Design rules
- Parameters to evaluate

**DEFINE LAYOUTS**
- PEM1a,b
- PEM2a,b
- PEM3a,b

**APPLICATIONS**
- Common Evaluation board meeting
  - Month
  - CEB 14
  - CEB 31
  - CEB 48
Foreseen business opportunities

Large area organic electronics will bring benefits to existing product families (RF-ID, sensors, smart objects etc.) and enable new applications (large area sensors, energy harvesting and storage, etc.).

- Touch displays
- Smart keyboads
- ..... 

SUI (SMART USER INTERFACE)

- sensors,
- memories
- transeivers
- ..... 

DAI (DISTRIBUTED AMBIENT INTELLIGENCE)

- Energy autonomous sensors
- RF-ID with added features
- Smart healthcare

SMART SYSTEM INTEGRATION SUI+DAI+EHS

- Solar cells,
- Energy escavenging
- Thin film batteries
- ..... 

EHS (ENERGY HARVESTING & STORAGE)