# IQE epitaxial products an innovative business case from Wales

WORKSHOP ON REGIONAL SMART SPECIALISATION FOR THE EU DEFENCE SECTOR
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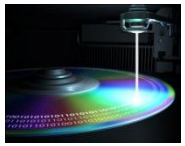
# Epitaxy .... Engineering advanced materials

**EPITAXY** → Chip Fabrication → Component Assembly

# Supply chain – advanced semiconductor devices



| Wavelength | | Material | Applications |
|---|---|---|---|
| Short | 300nm (UV) | AlN | Medical (including dermatology/sterilisation) |
| Visible | 400nm (blue/green) | GaN | LEDs and lasers and high-power electronics / RF |
| | 650nm (red/near IR) | GaAs | Optoelectronics and wireless communications |
| Long | 1000nm (mid IR) | InP | Fibre optic communications |
| Very long | 2000nm+ (far IR) | InSb/GaSb | Thermal imaging |

Mix of SME's and Large organisations in the chain.
Geographically dispersed

End users

- Consumer,
- Industrial
- Def & Sec
- Space

Systems

Subsystem

Packaging

Device Fabrication

Epitaxy

Substrates

Source Chemicals

Lasers

MMIC's

Photo Detectors

Power Transistors

IQE – Europe (Cardiff)
~60 staff

**Reflects "Open innovation"**

**The use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. This paradigm assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology."**

Henry Chesbrough, *Open Innovation: Researching a New Paradigm* (2003-2006)

# Outline

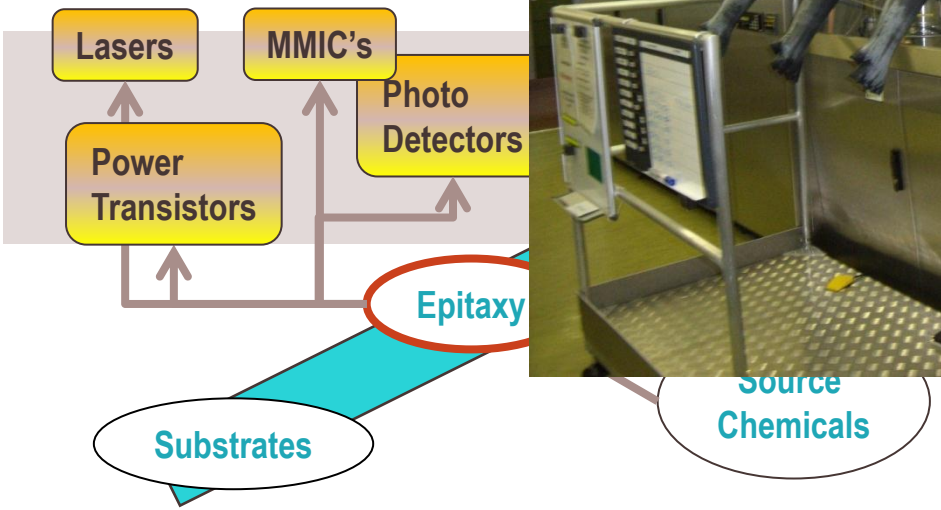
- Drivers
  - Value from synergy between defence and civil markets.
- Challenges
  - Time line challenges - the evolution from Science to Production for complex supply chains.
- Good Practice
  - Value of joint–European collaboration in technology development . (inclusion of industrial & technology partners)
- What helps
  - Clarification of the Complex mesh of programmes: European, national, regional; civil, space, defence; KET's, smart specialisation, grand challenges.
  - Use of TRL's … to reduce risk

# Drivers

## Value from synergy between defence and civil markets.

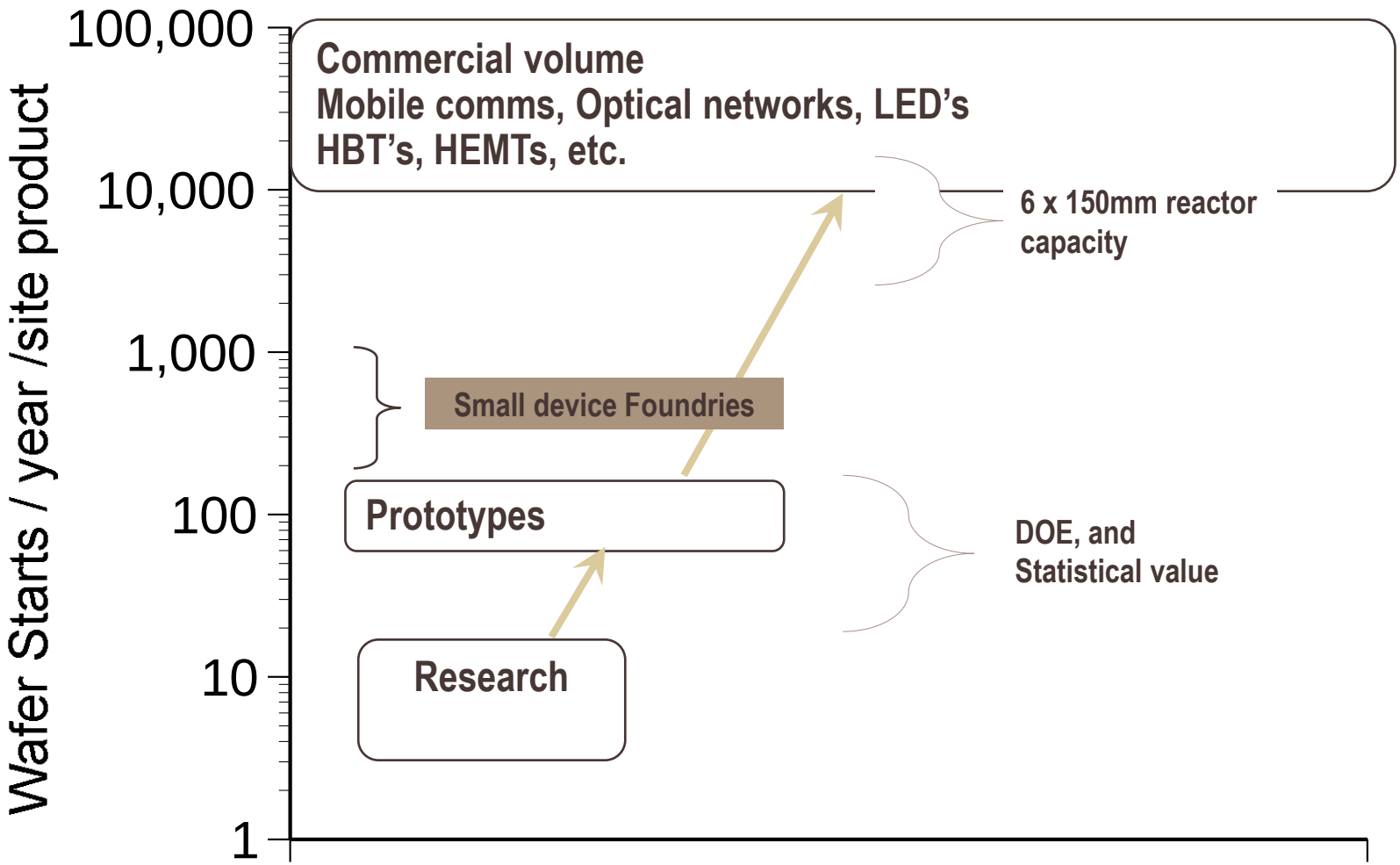
- Operation in both markets can bring continuity & gearing
  - Semiconductor growth equipment and facilities are capitally expensive
- Defence often takes a long term perspective of technology
- But COT's and their derivatives are very important

# Value of working in diverse markets




- Generic capabilities are relevant to a number of end applications.
- Working across sectors provides gearing of infrastructure
- ? low volume niche (civil or military) simultaneously with consumer (GaAs)

# Volumes

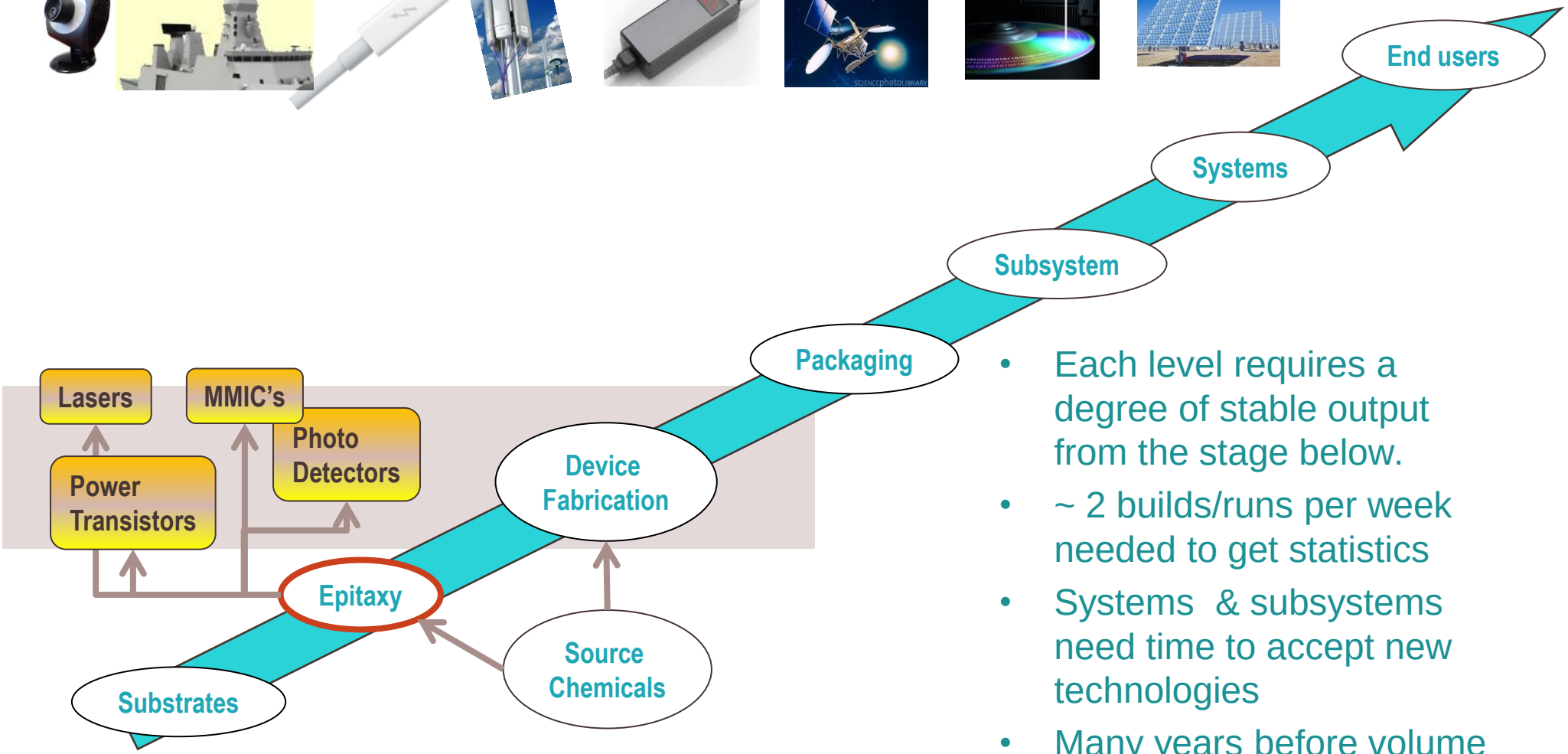

Wafer Starts / year /site product
100,000
10,000
1,000
100
10
1
Commercial volume
Mobile comms, Optical networks, LED's
HBT's, HEMTs, etc.
6 x 150mm reactor capacity
Small device Foundries
Prototypes
DOE, and
Statistical value
Research

# Challenges

**Time line of the evolution from Science to Production for complex supply chains.**

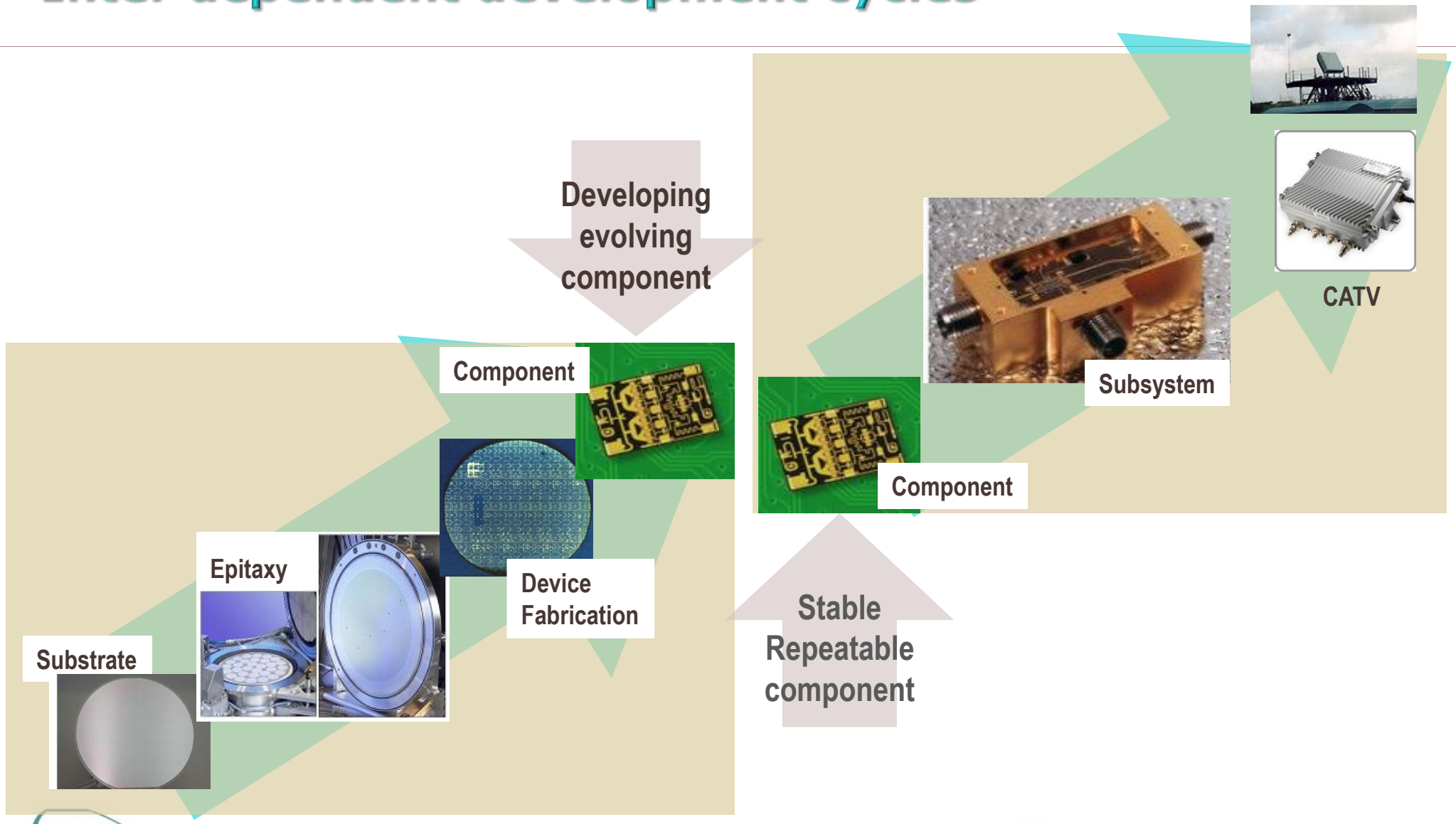
- **With complex technology a significant time is required to cross the valley of death**
- **Stable output required at the product / prototype (not production) stage**

# Challenge: - Time Line




- Each level requires a degree of stable output from the stage below.
- ~ 2 builds/runs per week needed to get statistics
- Systems & subsystems need time to accept new technologies
- Many years before volume

# Inter dependent development cycles



# Good Practice

## Value of joint–European collaboration in technology development . (inclusion of industrial & technology partners)

- The right technology programme can be of considerable benefit e.g. KorriGaN
- Brought the leading proponents from most nations together.
- Duplication to provide resilience and involvement of industrial supply chain

# Key Organisation for Research in Integrated Circuits in GaN Technology: KorriGaN

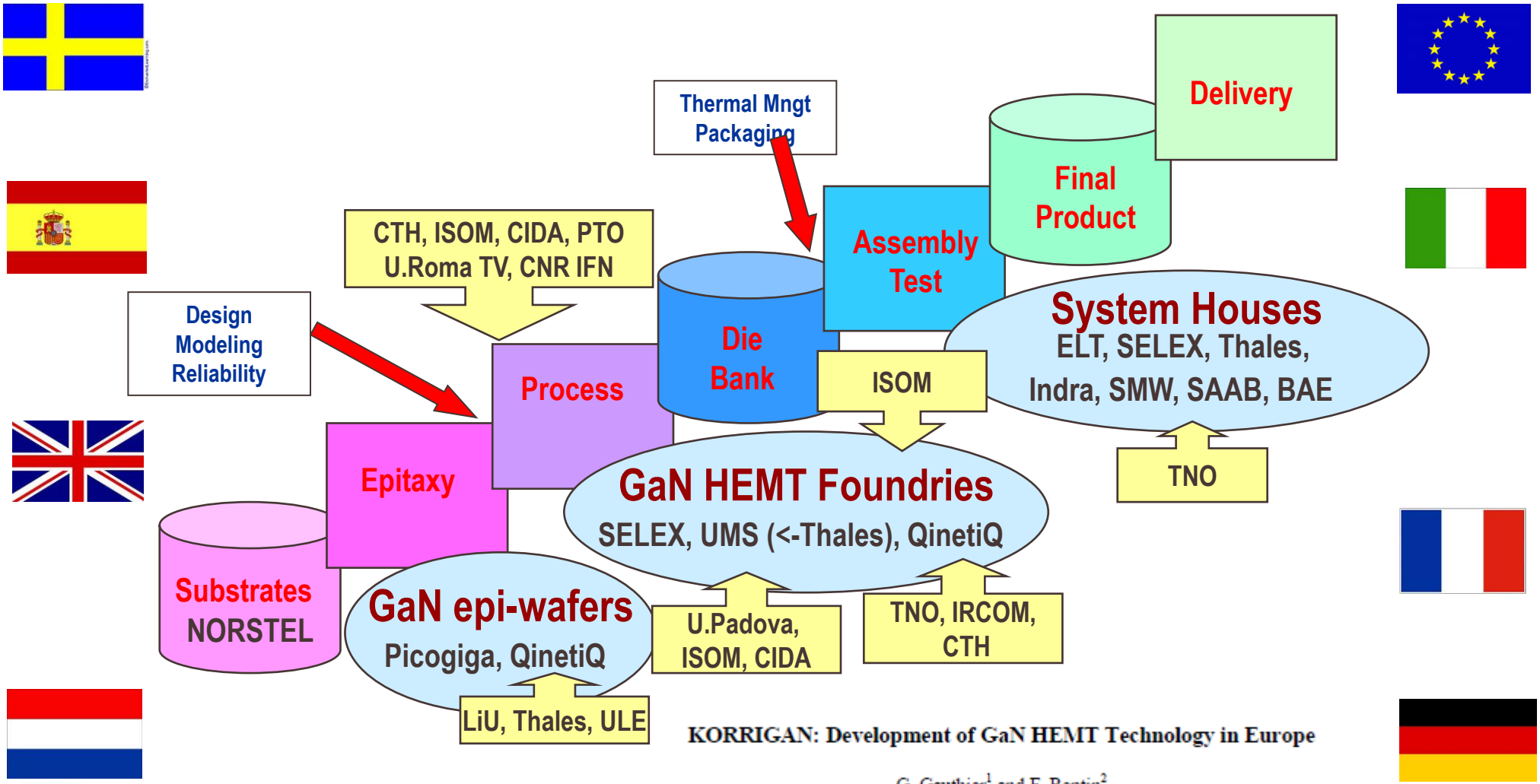
- Involved all EU countries with activities in RF GaN

- Objective.
  - demonstrate the technology of GaN HEMT devices and circuits (not products or production) in a European supply chain.

- Large European Collaboration
  - 7 nations, ~ 29 organisations
  - Academia, RTO's, Industry
  - inclusive

- 4 Year programme
  - Jan 2005 - July 2009

# EUROPEAN SUPPLY CHAIN




**KORRIGAN: Development of GaN HEMT Technology in Europe**

G. Gauthier[1] and F. Reptin[2]

CS MANTECH Conference, April 24-27, 2006, Vancouver, British Columbia, Canada

# What helps

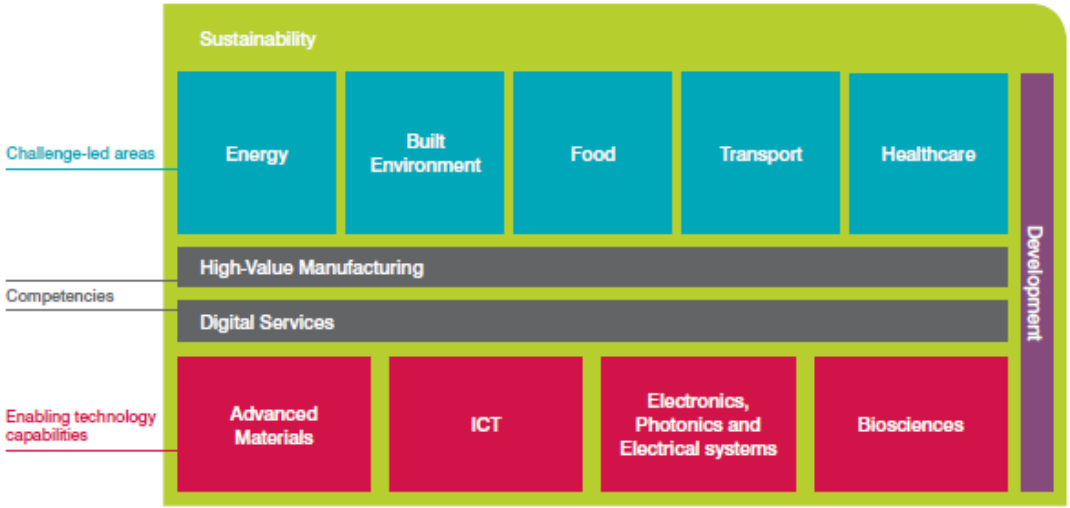
**Clarification of the mesh of programmes:**

- Difficult for an SME to translate between them for the multitude of technology, application and markets involved

# A World beating Industry in Europe …. Job creation , wealth creation, IP creation ……

## ……. So many pieces to the support puzzle

- European
  - Horizon 2020
    - KETs
    - SMART Specialisation
  - Global challenges
- National Strategies
  - Industry
  - Academic
- Initiatives
  - Grand Challenges
  - Innovation platforms
  - Feasibility projects
  - Collaborative
  - Partnerships
  - Themes
  - Technology Platforms
  - Defence
  - Space
- Globalisation

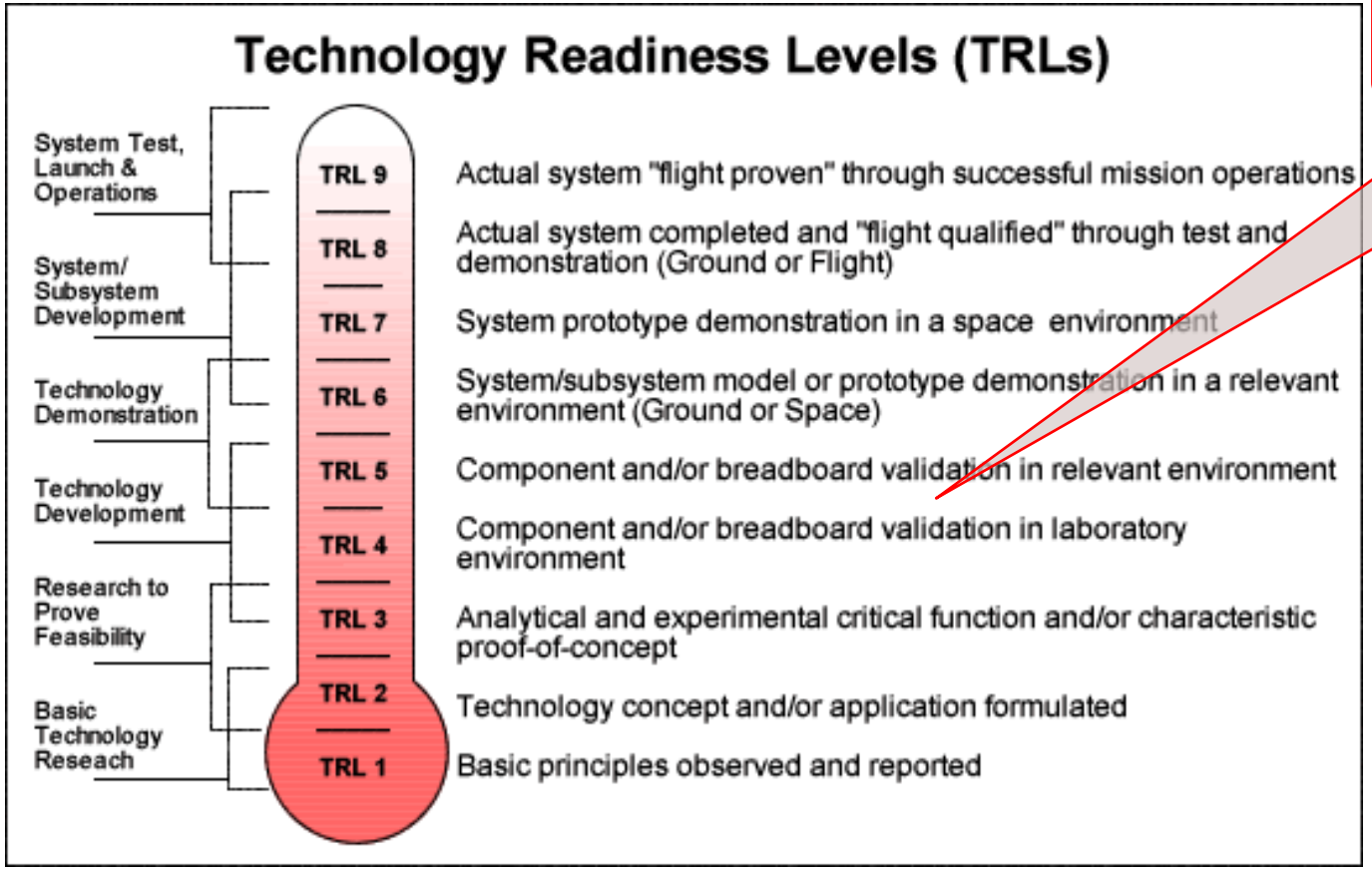


# What helps

## Recognition of TRL's to assist evolution

Critical to understand the maturity of technology.

# TRL, MRL, SRL




Significant differences in "Validation" when viewed from low or high TRL's

- Technologies towards the low end of the supply chain are frozen by TRL 5
- Progress through TRL is not quick

Acknowledgement: NASA

# THANK YOU
# QUESTIONS ?