



The Leverage Effect of Photonics Technologies: The European perspective

*Study prepared for the European Commission, DG
Information Society and Media SMART2009/0066*

in cooperation with  PHOTONICS²¹

Maurits Butter, Miriam Leis, Marijn Sandtke (TNO)

Mick McLean (Technologia), Alastair Wilson (Electronics, Sensors, Photonics
Knowledge Transfer Network, ESPKTN)

John Lincoln (ESPKTN , SEPNET & Harlin Ltd)

Outline

- Objectives and Definitions
- Current photonics market
- Impacted markets
- Leverage
 - *Breadth & depth*
 - *Now & in future*
- Value chains
- Conclusions

Objectives

Ok, Photonics is important

How important?

How can we make most of this?

Where are we vulnerable?



- Quantify Leverage of photonics on applications and markets***
- Illustrate impact on new market development***
- Assess the socioeconomic and environmental impact***
- Inform structuring of framework 8***

What is Photonics Leverage?



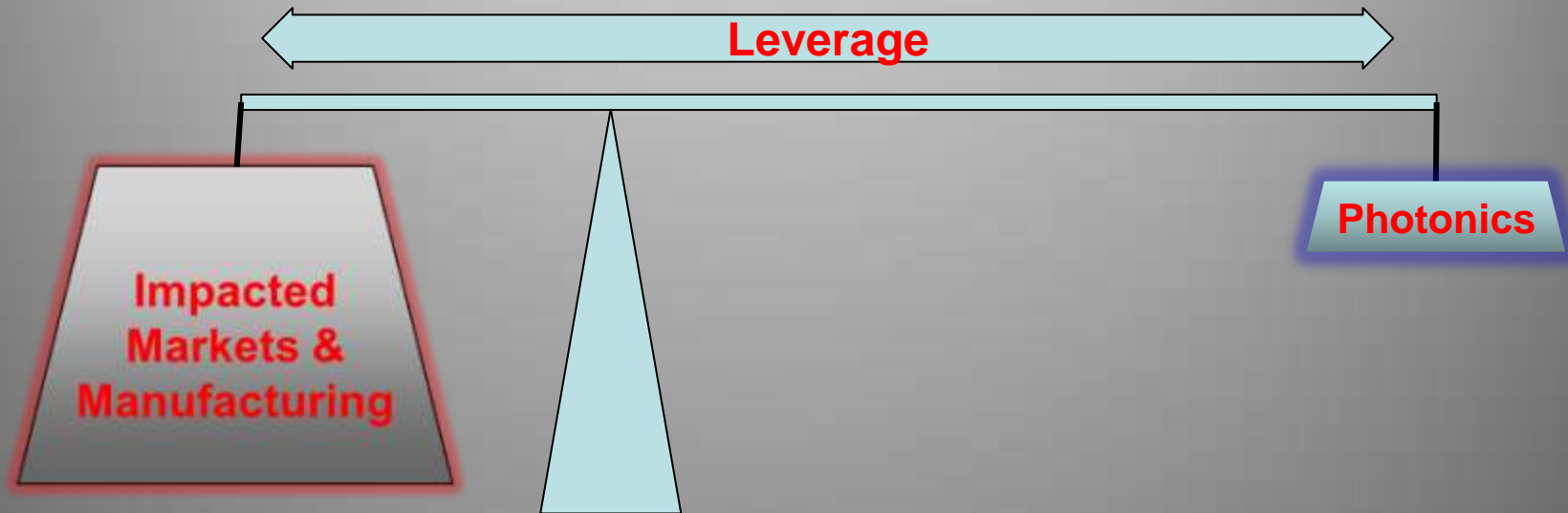
How many **valued** features/benefits depend on photonics?

If photonics removed what proportion of **valued** features/benefits lost?

With no photonics embedded in product or used in manufacture-how competitive would product be?

Leverage = “The contribution photonics makes to the value of an end product/service without which the end product would not be competitive”

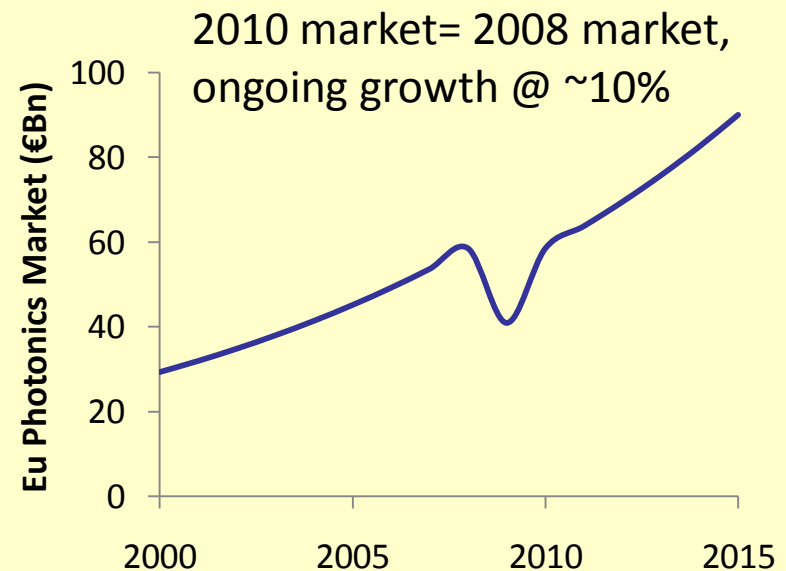
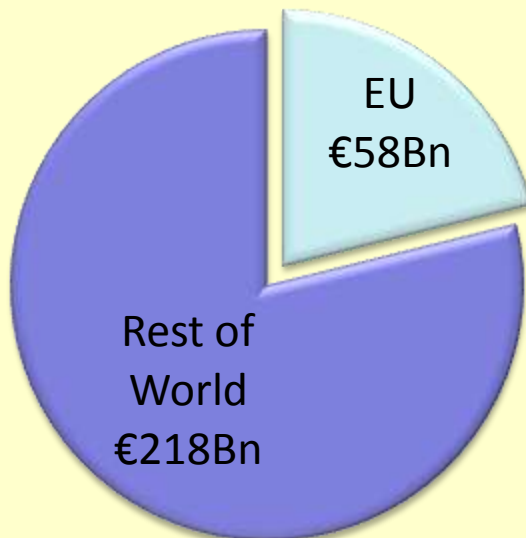
Quantify Leverage



- Photonics market leverage (PML)
 - *EU trade leveraged by photonics (Euros)*
- Photonics employment leverage (PEL)
 - *EU jobs leveraged by photonics (numbers of people)*
- Ratios
 - *To total Eu trade & employment*
 - *To size of photonics industry*

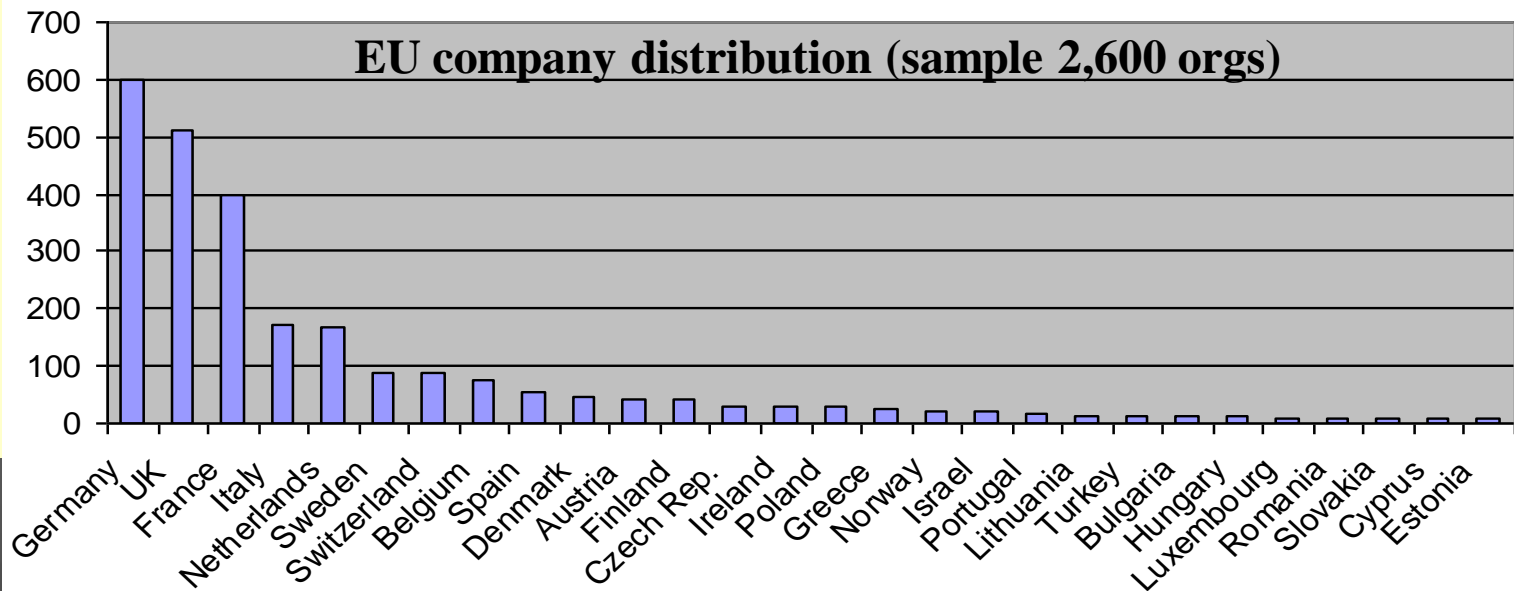
Current photonics market

- Starting point is current photonics market
 - Based on previous studies, extrapolations and updates from clusters
 - *Global Photonics Market €277bn, European €58bn*
 - *Eu Photonics employment ~290,000*
 - EU 20-25% of world photonics industry
 - Long term growth >> general industry.

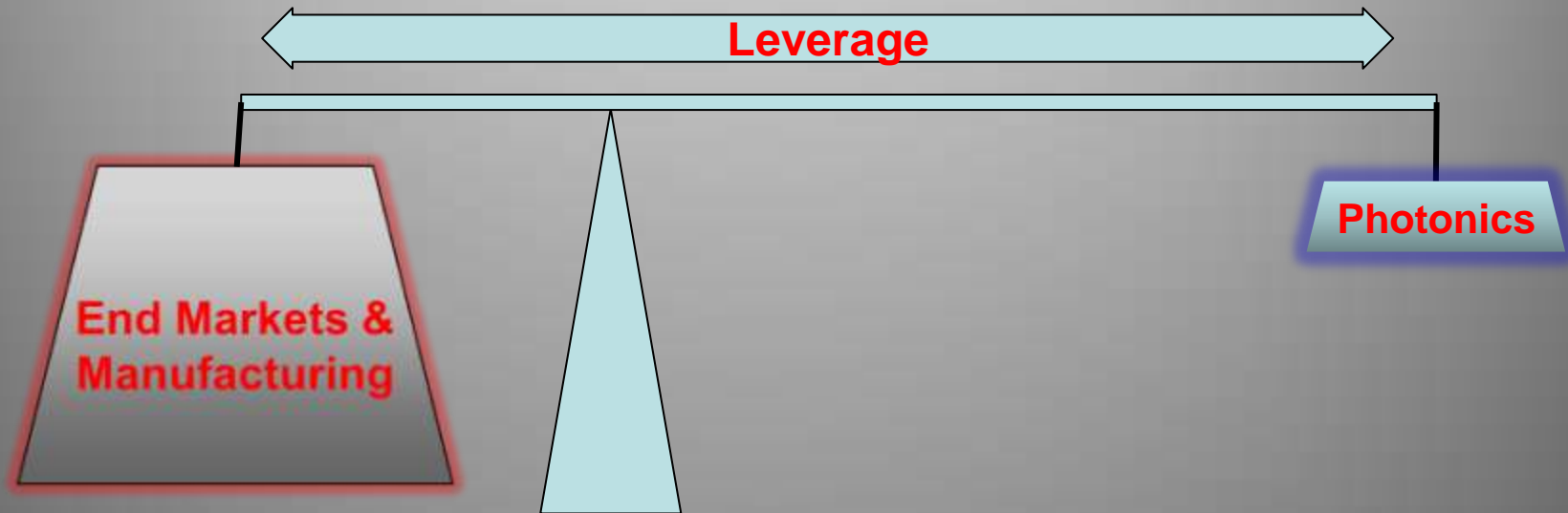


The European position

- 5000 photonics companies
 - 2000 research units in ~400 universities/research orgs
- Strength and depth in photonics research
 - Especially laser technology, Thin film, nanophotonics, photonics design.
- Significant on global scale
 - Significant number of multinational companies
 - Present all segments - Leader in some, marginal in others



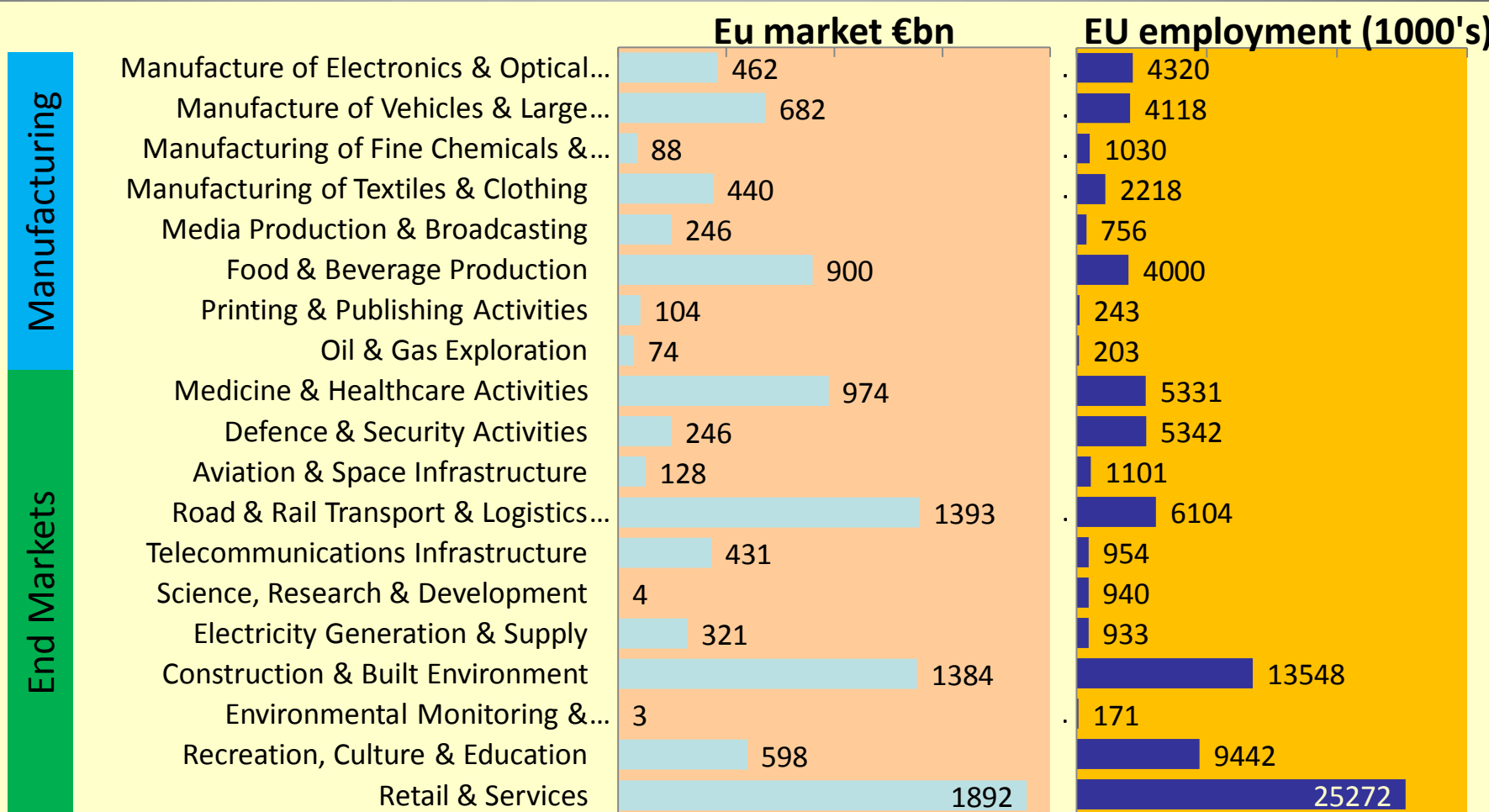
Quantify Leverage



- Photonics market leverage (PML)
 - *EU trade leveraged by photonics (Euros)*
- Photonics employment leverage (PEL)
 - *EU jobs leveraged by photonics (numbers of people)*
- Ratios
 - *To total Eu trade & employment*
 - *To size of photonics industry*

Impacted markets

- Identify principle markets directly impacted by photonics
 - Size from Eurostat/ NACE irrelevant sub-segments removed



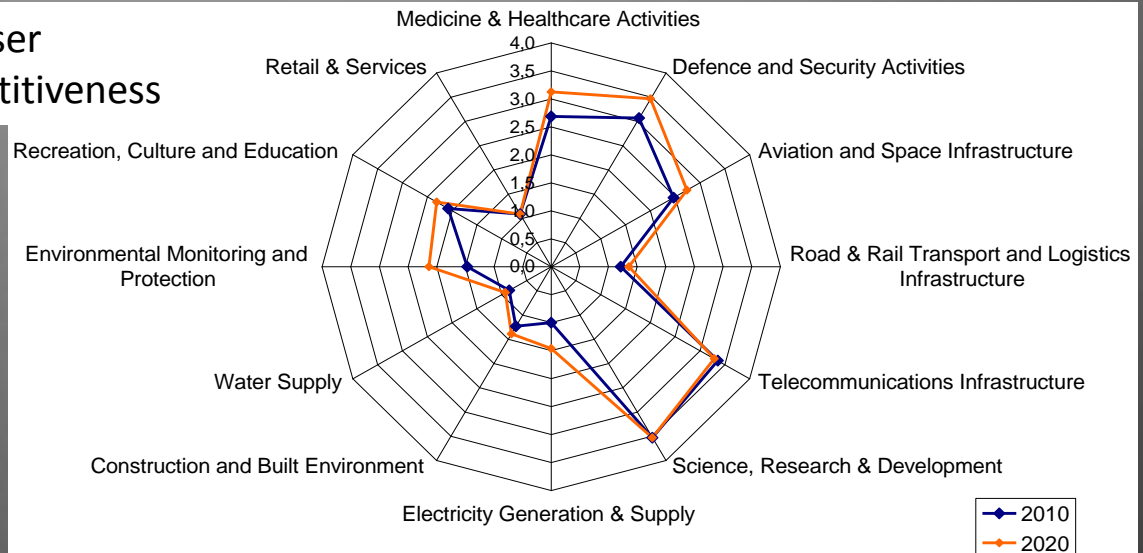
Photonics influence

• How critical are 6 photonics technologies to 20 industries?



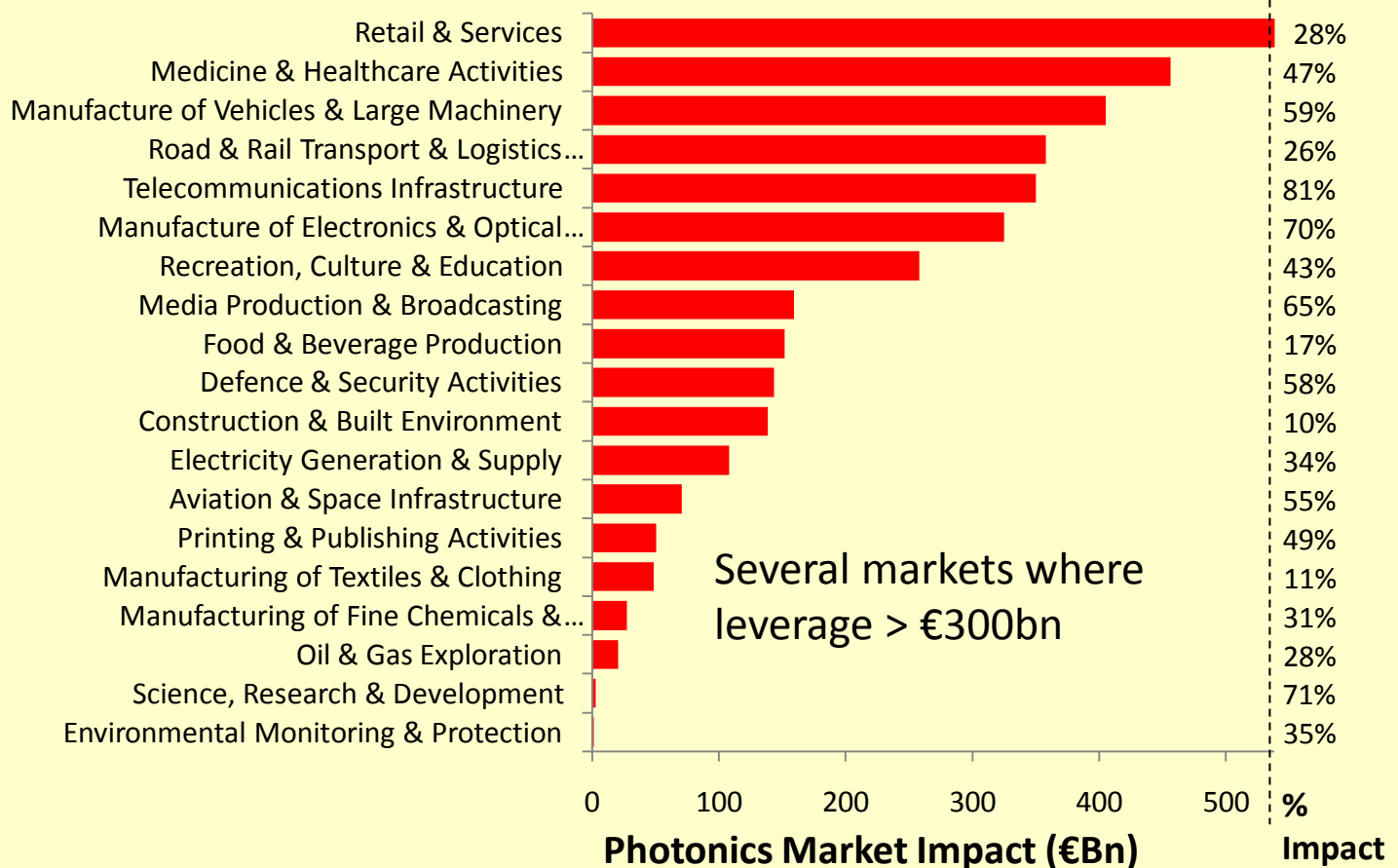
- By Survey 2010 & 2020
- Scale from irrelevant to crucial for competitiveness
- Shows current & future impact.
 - Quantify to leverage impact measure

E.g. Contribution of Laser technologies to competitiveness



Leverage

- Combining size of impacted markets with level of impact
 - Photonics market impact = ~€3trillion**
 - Photonics employment impact = ~30 million jobs**



Meaning of Leverage

- What drives this number?
 - *Combination of market size and impact/ criticality*
 - Size markets as important as level of impact
 - Absolute size of Photonics leverage significant in large markets where photonics influence modest.
- Leveraged markets not exclusively dependent on photonics.
 - *Multiple technologies required to maintain competitiveness*
- Quantifying leverage is new
 - *Experimental methodology*
 - Benchmarking against other technologies needed
 - *Gives order of magnitude indication.*
 - Many adjustments possible – impact remains €2-4trillion

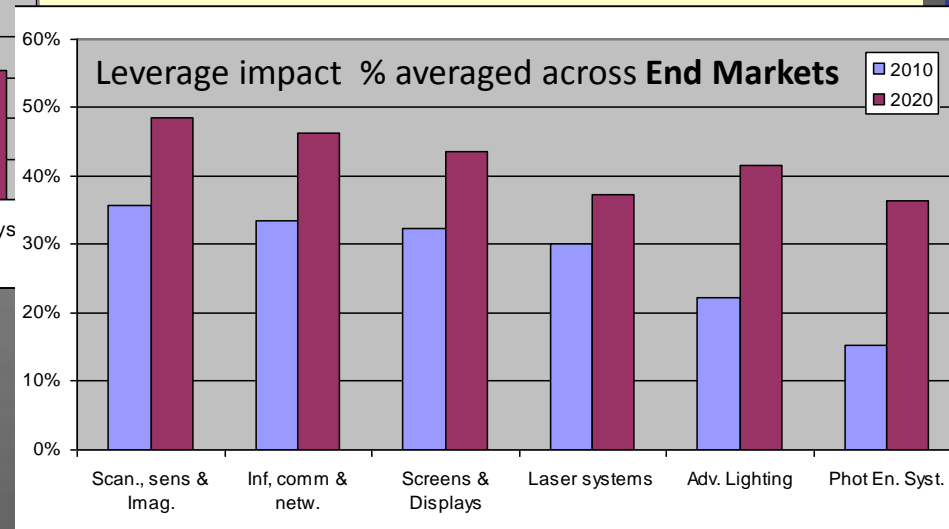
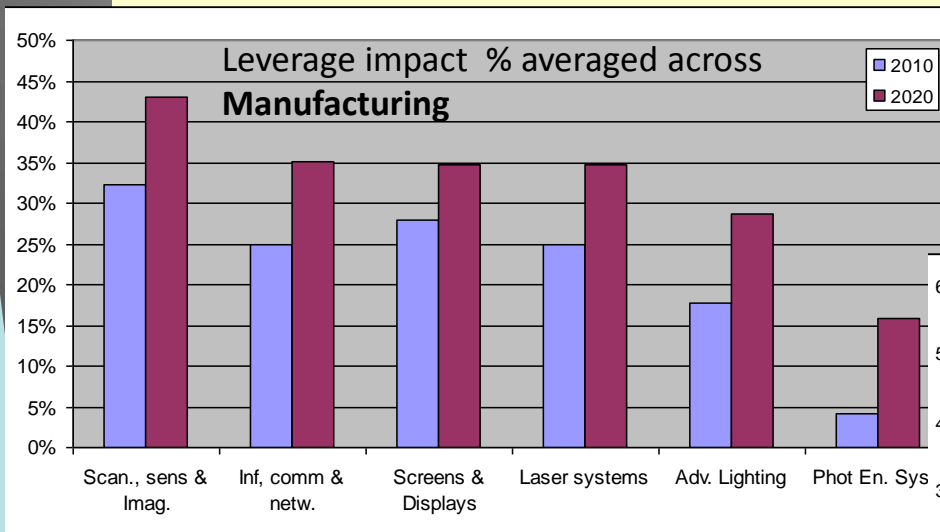
Leverage comparison

- Photonics impacts > 10% of Eu GDP
- Photonics relevant to ~14% of Eu jobs
- Eu Photonics market impact ~60X size of EU photonics market
- Eu Photonics employment impact ~100X EU photonics employment
- Impact is highly diverse
 - *Multiple photonics technologies impacting multiple industries in both manufacture and final product.*

Future Impact

- Looking at average impact across all sectors
 - Based on averaging survey results , excluding market data
 - i.e independent sector size
- Leverage of all photonics technologies increasing

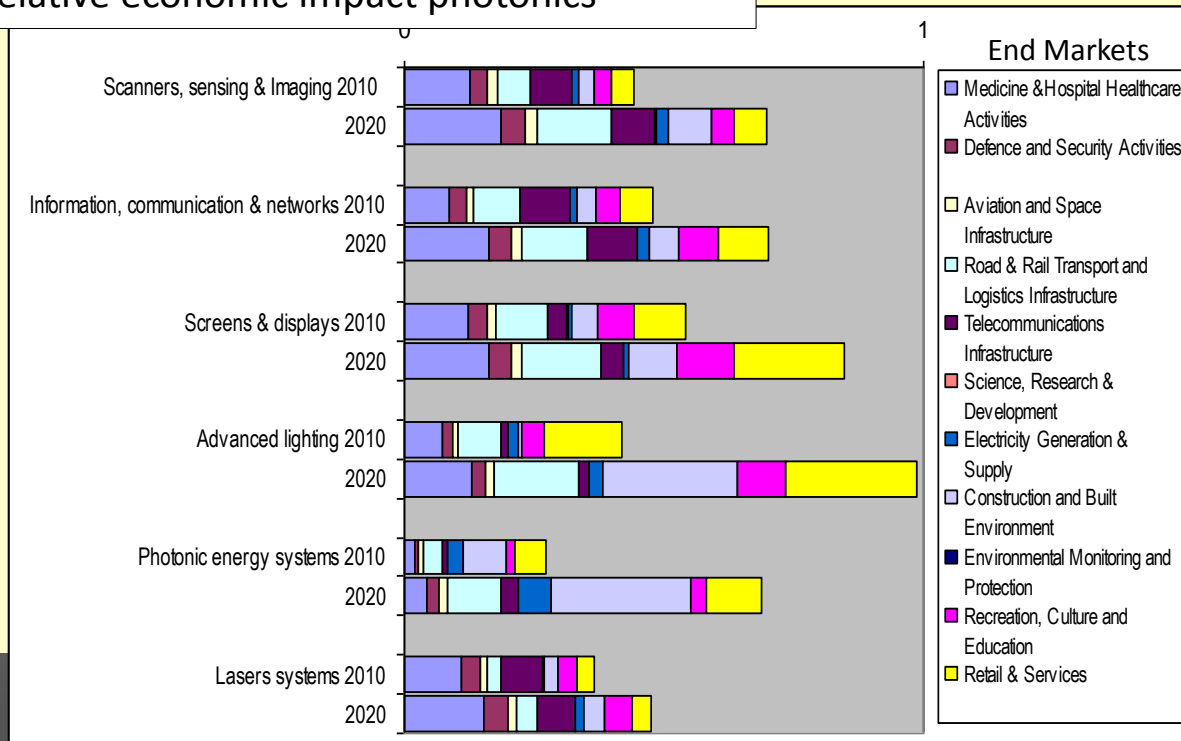
- Highest change in solid state lighting and Photonic energy systems



Breadth of leverage

- Leverage of different photonics technologies
 - Combining impact with market size
 - Shows relative economic impact
- Impact highly diverse and distributed
 - *No one market is dependent on one photonics technology*

Relative economic impact photonics



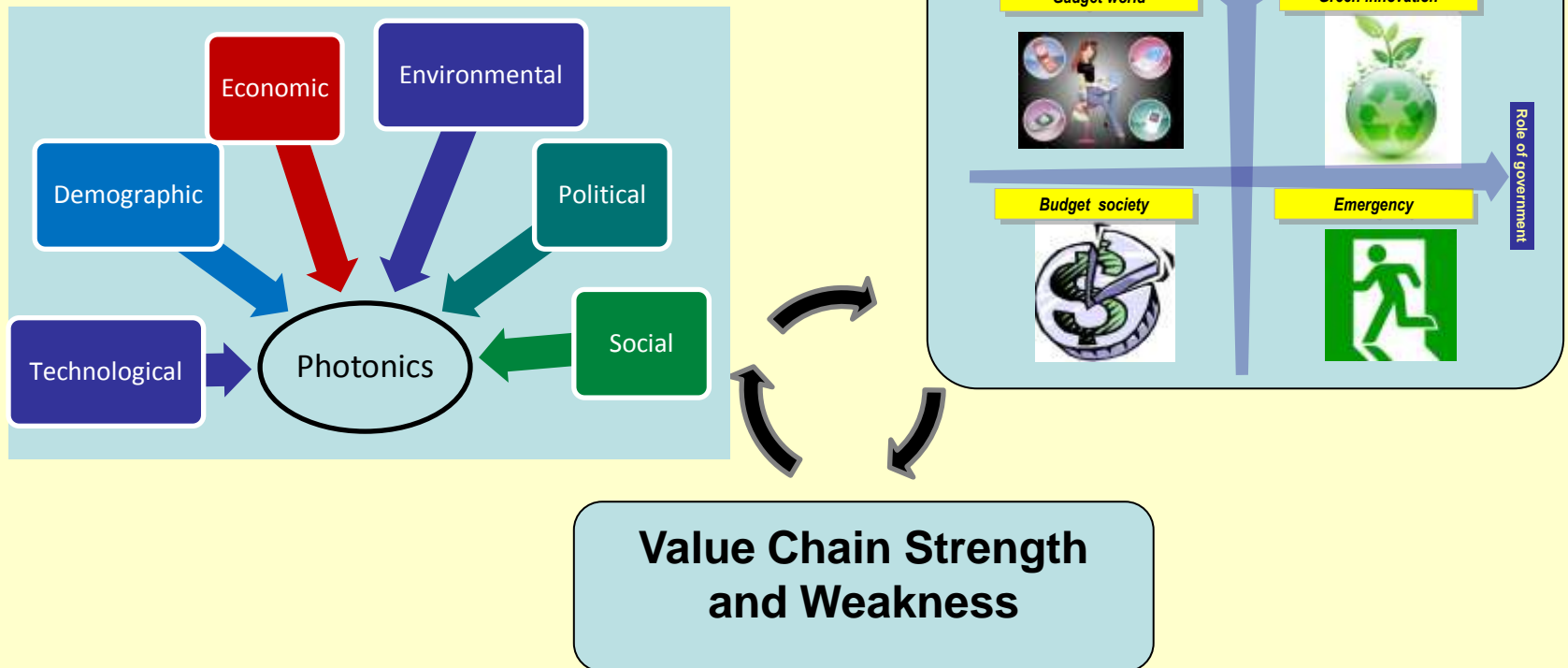


TECHNOLOGIA

VALUE CHAINS

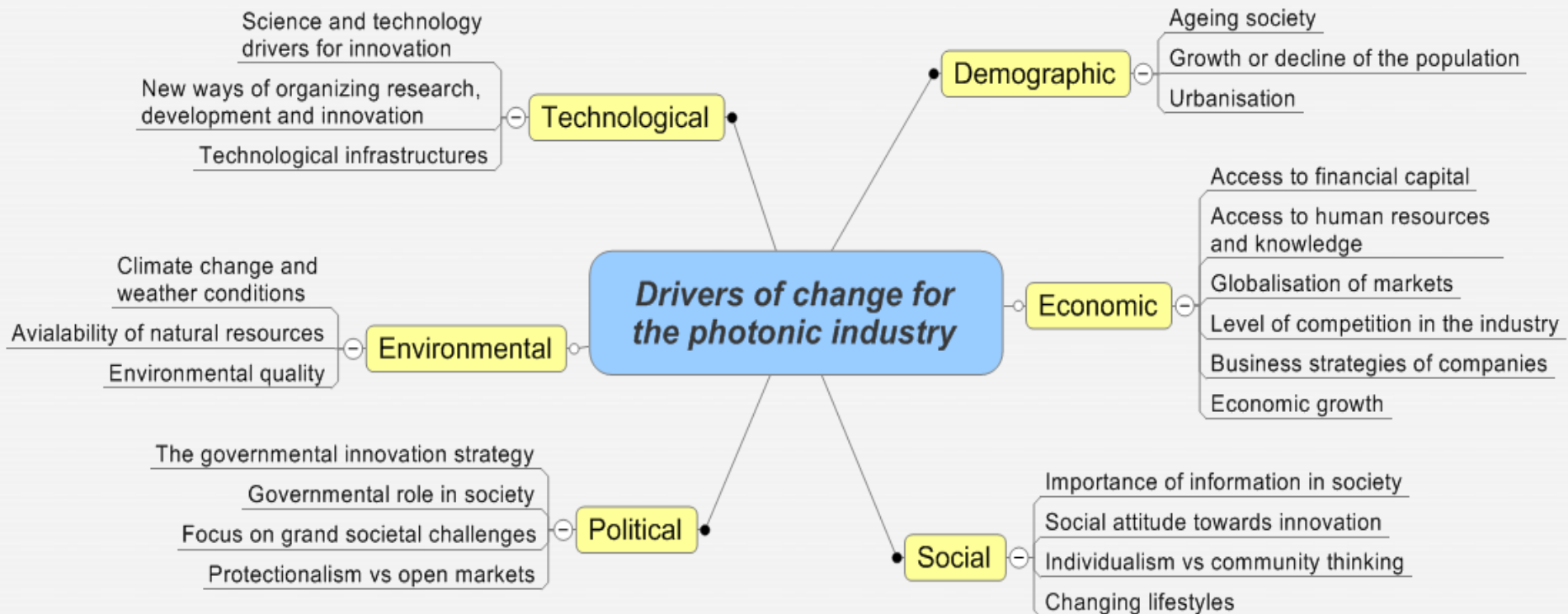
Value chain analysis

- Analysis of 6 photonics technologies value chains
 - *Under drivers for change & 4 future scenarios*
 - Expose strengths and weaknesses



Drivers of change

- What is driving change?



Value chains – general conclusions

- Photonics is constantly in a high state of flux,
 - *But EU photonics is robust against future developments, because of high levels of research and innovation*
- Almost all value chains show a high potential for economic growth and increasing impact on competitiveness
- Overall social benefits are positive, especially for societal challenges.
- Focus on energy and greening is crucial for environmental and economic sustainability.
 - *The environmental impact often complex with increased efficiency counteracted by increased use & complex waste*

Value chains – general conclusions cont.

- Horizontal links within many value chains are not European, but global;
 - *EU photonics market strongly linked to global market.*
 - *Cannot consider EU in isolation.*
- Lack of volume production can clearly be seen in some value chains
 - *Can weaken linkages in European research to industry*
- Focus of EU research & industry is on high performance, low volume, highly innovative markets
- The relationship between governments, research and industry is a crucial factor to competitiveness and innovation
 - *Especially due to the focus on high performance markets.*

Value chain- SWOT analysis specific conclusions



- Scanning, sensing & imaging
 - *Diverse research base but underrepresented in manufacture of some volume components*
 - *Application in manufacturing significant with world players in EU*
 - *Positive social impact especially in healthcare & security*
- Information, communication & networks
 - *Research and complex hardware production still strong in EU*
 - *but market highly internationalised*
 - *Demand for high quality infrastructure = positive economic impact,*
 - *Enables enhanced competitiveness & economic growth for wide range of other industries and markets.*

Value chain SWOT analysis – specific conclusions cont.



- Screen and displays
 - *Eu focused on high performance & new display technology*
 - Main production is outside EU, bar niche high performance products
 - *Displays are very strong driver for product competitiveness*
 - *Along with info and comms potentially strong social impact via better healthcare, education and security*
 - But dangers of information overload and exclusion.
- Advanced Solid State Lighting
 - *Eu strong lighting related research from multiple disciplines*
 - Supply of high efficiency LEDs dominated by small number companies
 - *Manufacturer of lighting fixtures is established in Europe with many smaller companies.*
 - *High potential growth leading to high reduction of energy use*
 - *New functionalities (smart lighting) will enhance the competitiveness*
 - *Some potential social impact in improved quality of lighting.*

Value chain SWOT analysis – specific conclusions cont.

- Photonics Energy Systems (PV)
 - *EU research in this area more limited*
 - *EU currently strong manufacturing industry, but increasing competition from China.*
 - *High potential growth, but strong dependency on governmental policy*
 - *Utilisation very uneven across EU*
- Laser systems
 - *EU research strong and well connected to industry*
 - *World leading position in high performance laser systems for manufacturing.*
 - *Weaker in production lasers for consumer electronics*
 - *High potential short term economic growth, albeit with increasing competition*
 - *Continued increasing utilisation in manufacturing*





TECHNOLOGIA

CONCLUSIONS

Conclusions - Observations

European photonics research and industry is globally significant & growing fast

Photonics has very significant leverage on >10% of European economy

- *Not just obvious markets,*
- *Large markets where photonics contribution modest are significant*

Leverage increasing across the board in next decade,

- *Biggest gains in construction, transport, retail - ignoring underlying market growth*

Overall weakness: Lack of volume photonics production.

- *Whilst overall research & industry links strong this is an area of vulnerability*

Overall strengths: High focus on High End markets,

- *Drives need for investment in photonics research*

Energy utilization crucial to all futures

Conclusions - recommendations

Focus on large sectors where photonics impact currently small, not just sectors where photonics impact established.

- *In particular high value non-consumer markets e.g. production equipment*

Establish a specific policy to support full SME participation at all stages of supply chains

Support the vertical connection between research and industry

- *May require inclusion of volume manufacturers outside EU*

Create an active policy to ensure the availability of highly skilled personnel

As government, actively participate in photonics

What next...

- More studies
 - *“Photonics Technologies and Markets for a Low Carbon Economy”*
SMART 2010/0066
 - Contact Ian Weir, Optimat Ltd.
 - *“Harnessing Light II”*,
 - National Academies of Science, Erik Svedberg
- The impact of quantifying impact
 - *Insiders are unlikely to be surprised, but how will those outside photonics react?*
 - Photonics is not new to us, but it is still not in everyday language
 - *More benchmarks needed*

**Getting photonics recognised as an enabling technology
is the start not the end.**

Acknowledgements



Maurits Butter, Miriam Leis, Marijn Sandtke

TECHNOLOGIA Mick McLean



Alastair Wilson, John Lincoln (Harlin Ltd)

EU Commission Photonics Unit

All experts involved in workshops and surveys

In corporation with  PHOTONICS²¹

Full reports available for download at <http://bit.ly/phlever>

Presentation available at http://bit.ly/ph_leverage

John.Lincoln@harlinltd.co.uk