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Paradigm shift in Lighting Control

SLL Masterclass 2014-2015
"Light for Life"

Topics

- The role of lighting controls in our daily lives

- The importance of user interfaces

- Shift towards intelligent networks

- Standardisation & Metrics

freedom in lighting **Helvar**

A holistic approach to entire light system

- Environment
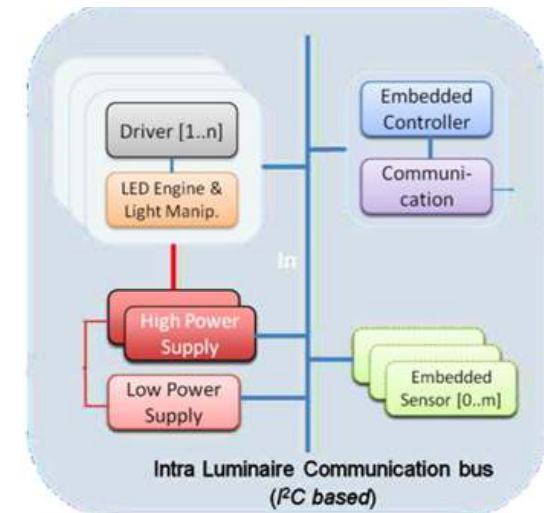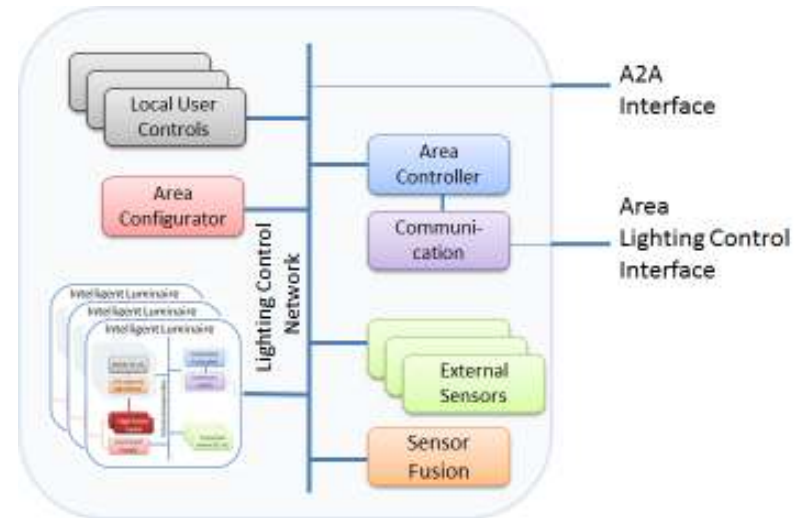 - Visual effects
  - Emotional effects
  - Biological effects

- Building Blocks
  - Module
  - Fixture
  - System

Sweco head offices in Stockholm, Sweden

The role of lighting controls in our daily lives

Importance of distributed intelligence

- **No central control**
  - Network topology

- **Autonomous Devices**
  - React rather than instructed

- **Decisions take place locally**

- **Connections to other networks**
  - Via local gateways
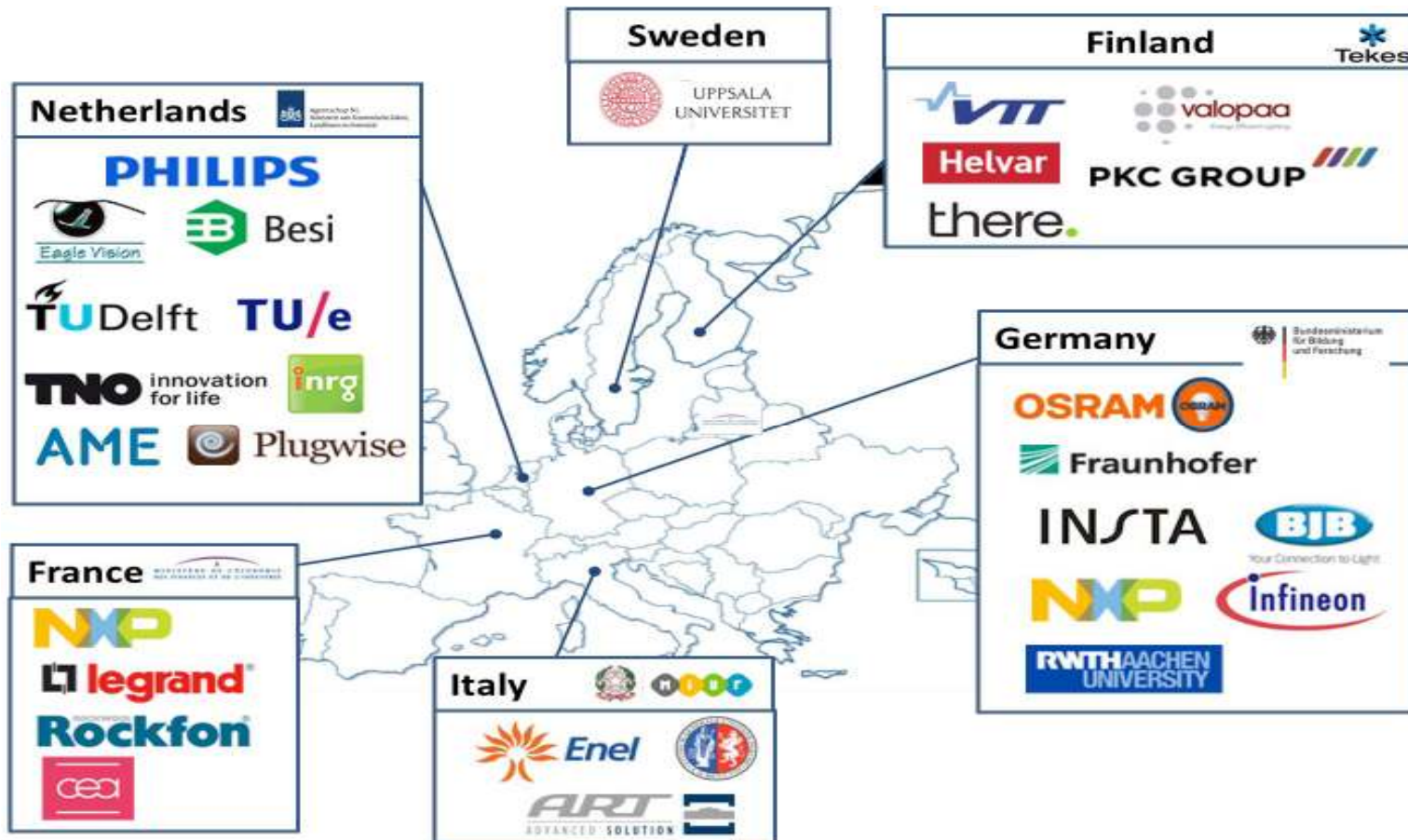
- **Future "Internet of Things"**

The role of lighting controls in our daily lives

Importance of distributed intelligence

ENLIGHT — Energy efficient and intelligent lighting systems

The role of lighting controls in our daily lives
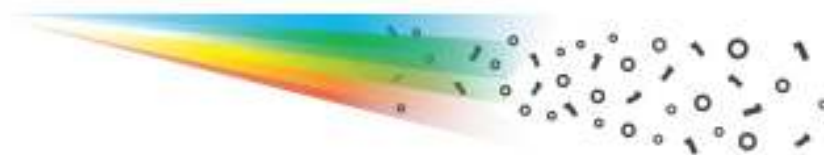
SMART lighting

- Perfect light level

- Colour temperature

- Motion Sensing

- Intuitive Learning

Light becomes data

pure**LiFi**

The role of lighting controls in our daily lives

Convergence of control philosophies

- Traditional to have separate control systems
  - Electric Lighting
  - Blind Control
  - HVAC

- Today system inputs shared by all systems

- Simplified commissioning methods
  - Improving operational efficiency's
  - Empowering the end user

The WTC Trust Tower, Abu Dhabi
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The importance of user interfaces

Tailored to individual user requirements

- Controls have come full circle
  - Simple on/off
 - Scenes
  - Complex Control

- Take Control

- Take ownership

The importance of user interfaces

Sea Change to soft applications

○ Traditional switches migrating to smart devices

○ Growth of smart devices
  - 2014, 70 billion mobile app downloads
  - 2015, over 80% handsets will be smart phones

○ Intuitive interface on common hardware
  - Tablets/Phones

○ Use inbuilt connectivity
  - Phone as presence detector
  - Commissioning tool
  - Scene editor
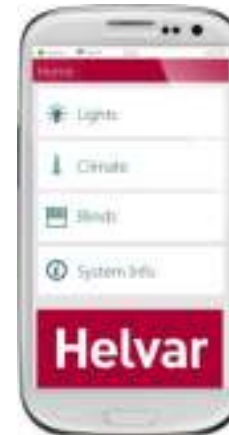
Integration with other systems

- Enhanced user experience
  - Mode
  - Safety
  - Security

- Possible uses
  - Televisions
  - Home Security Systems
  - Home appliances
  - Smoke detectors
  - Door locks

Understanding the impact of lighting

○ Sensors primarily are there to save lighting electrical energy.

○ Their data can also shared by other systems.

○ What else can they offer/achieve?
- Measurement of Colour Temperature
- Mapping of building usage
- Heating/load shedding
- Access control & security

Human Benefits of SMART lighting systems

Human Centric Lighting

- 2000's scientific discovery revealed: human biological rhythms are influenced by specific light conditions

- Lighting has tremendous effects on human health, productivity and well-being

- Advanced lighting systems can support the human circadian rhythm, enhance concentration, prevent sleeping disorders and improve overall well-being

Human Benefits of SMART lighting systems

Application-specific effects of human centric lighting

Health
- Enhanced drug efficacy, e.g. of antidepressants
- Reduced therapy times and capacity requirements

Wholesale and Retail
- Daylight-compatible product presentations
- Extended daytime in shopping malls

Education
- Decreased fatigue and shortened wake-up times
- Extended and deepened concentration periods

Hospitality
- (Colored) accentuation of architecture and design
- "Mood support" in wellness and dining areas

Office
- Increased employee motivation and commitment
- Individualized maximization of concentration and energy

Residential
- Prevention of depressions, dementia etc.
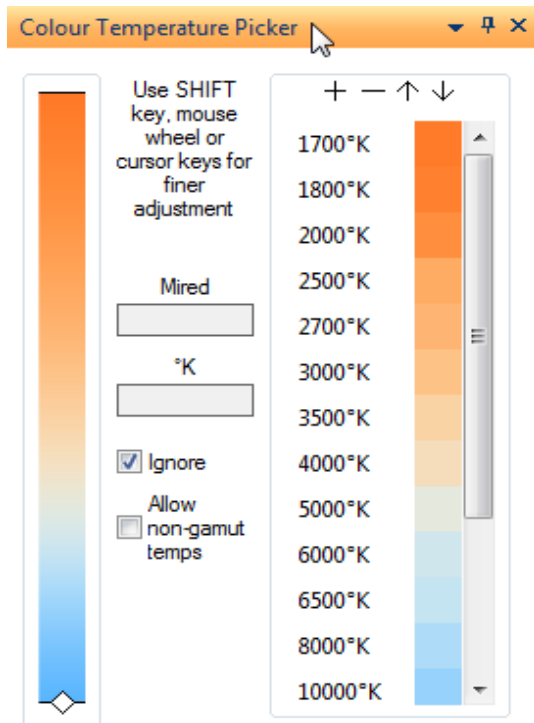- Integrated wake-up and relaxation support

Industrial
- Improved output and error rates of repetitive work steps
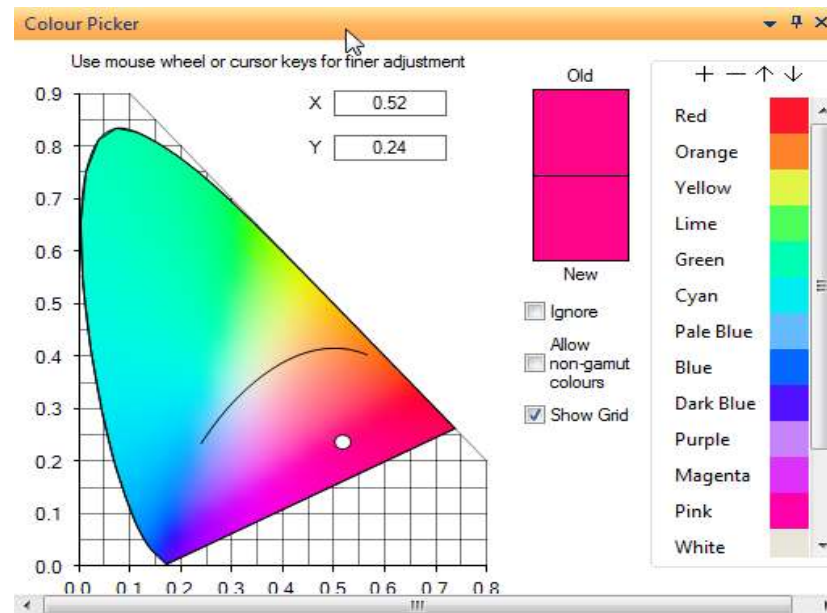- Biorhythm adjustment for nightshift workers

Colour Control

○ This is not a new concept but has now become a more economical solution

○ Selection for Colour Temperature

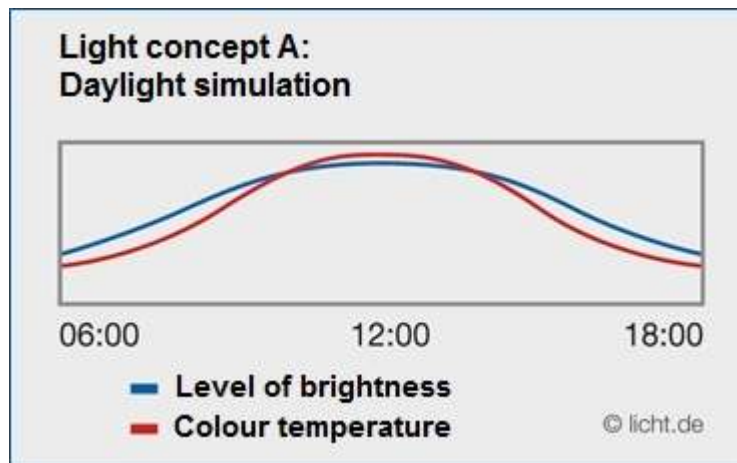○ Colour Hue & Saturation are controlled using CIE Chromaticity diagram

Complement Circadian Rhythm

- **Dynamic Adjustment over time**
  - Intensity
  - Colour Temperature
  - RGBW

- **Pre defined patterns**

Office, Hospital

Light concept A:
Daylight simulation

06:00   12:00   18:00

— Level of brightness
— Colour temperature

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School

Light concept B:
Activation

— Level of brightness
— Colour temperature

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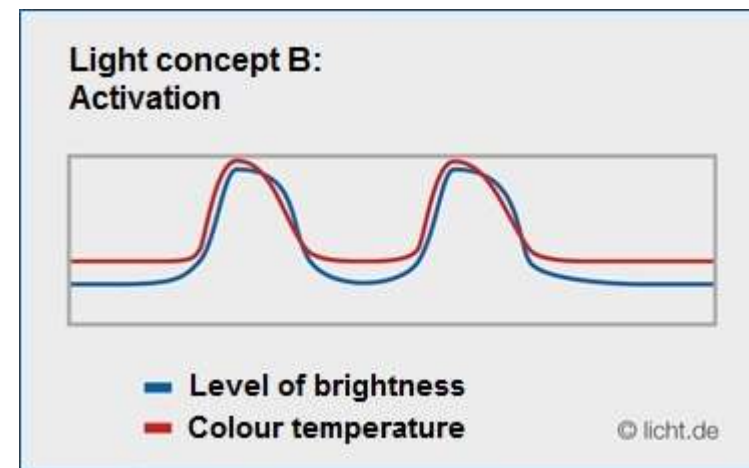
Linking the science to control philosophies

- Science already tells us of the benefits of HCL
  - The Why

- Manufacturers have the technical expertise to create meaningful solutions.
  - The How

- Traditionally the link between the two is missing.

- Initiatives trying to bridge this gap
  - Enlight
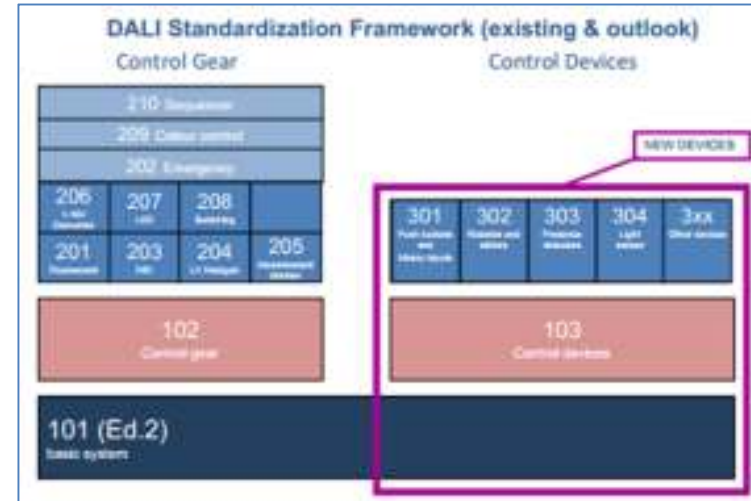 - Lighting Europe
  - Lighting for People

Standardisation & Metrics

Maximising the adoption of new technologies

- **Standards**
  - DALI Colour Control
  - DALI 2
  - Wireless
    - Zigbee
    - Z-Wave
    - Bluetooth
  - Power Over Ethernet

DALI Standardization Framework (existing & outlook)

- **Metrics Today**
  - Illuminance
  - Daylight Factor
  - Colour Rendering Index (CRI)
  - Luminous Efficacy

- **Metrics Tomorrow**
  - LENI calculation
  - Climate Based Daylight Modelling
  - Colour Rendering & Brightness perception
  - Universal luminous efficiency function
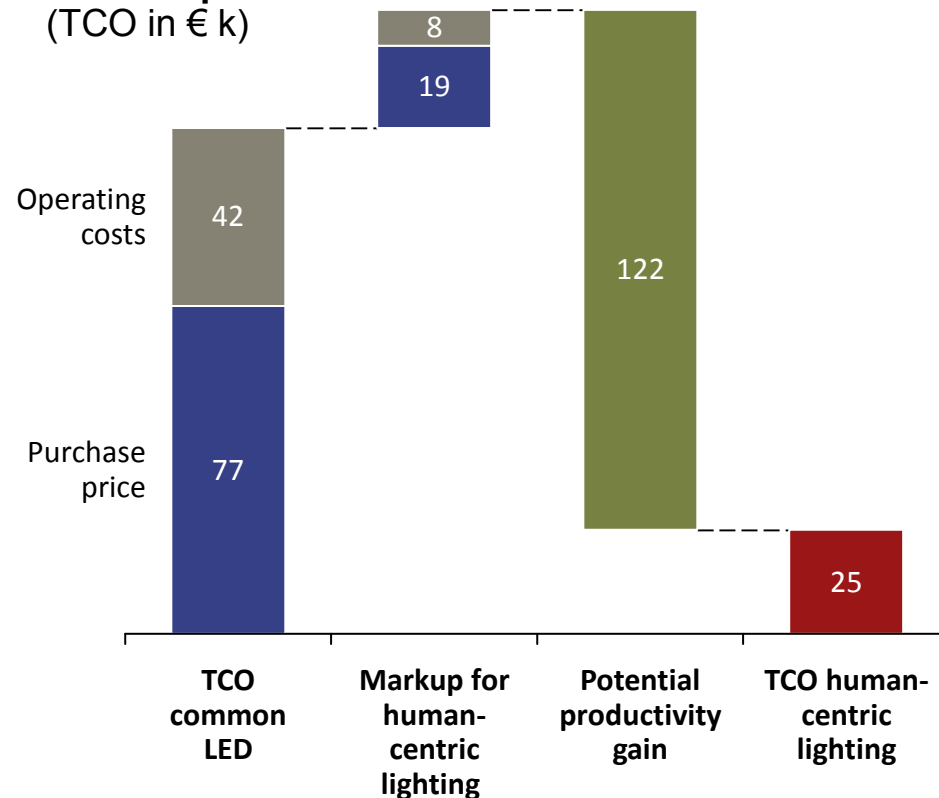
Standardisation & Metrics

Economies of Scale

○ Lighting should be based upon value where *both* benefits and costs can be measured

○ Huge array of different solutions available today
  • KNX, EnOcean, Zigbee, Z-Wave, Bluetooth

○ Common agreement is needed as to best way forward.

○ Lessons to be learnt from the IT world
  • e.g. Wi-Fi

$$\text{Value} = \frac{\text{Perceived Benefits}}{\text{Cost}}$$

Potential Cost of Ownership

Business case HumCL[1] vs. common LED – Factory workshop
(TCO in € k)

Operating costs

Purchase price

| TCO common LED | Markup for human-centric lighting | Potential productivity gain | TCO human-centric lighting |

- Only 1.7% increase in productivity required to off-set higher purchase prices & operating costs
- Studies indicate potential productivity improvements of up to 7.7%
- Assumptions:
  - Workshop area of 1,500m^2
  - HCL with 25% higher purchase price and 20% higher power consumption than common LED
  - 10 employees, each completing 6 tasks per day with a contribution margin of €12/task
  - Potential productivity gains of €12.2k p.a[2]
  - TCO calculated over a period of ten years

1. Human centric Lighting
2. Calculation: 7.7% * 6 (tasks/day) * 12€ (contribution margin/task) * 220 (work days) * 10 (employees) = €12.200

Sources: A.T. Kearney; Lichtwissen 19 (p. 30) based on Juslén Henri, 2007: Lighting, productivity and preferred illuminances - field studies in the industrial environment. Helsinki University of Technology.

Conclusions

- We have only just begun to understand the benefits of Human Centric Lighting

- The journey of learning will continue for many years to come.

- New/future technologies will alter this journey.

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Thank you